CRUISE REPORT
C-106

SCIENTIFIC ACTIVITIES

23 MAY 1989 - 3 JULY 1989

SSV <u>CORWITH</u> <u>CRAMER</u>

Sea Education Association
Woods Hole, Massachusetts

SEA EDUCATION ASSOCIATION CRUISE C-106

SHIP:
SSV *CORWITH CRAMER*

DATES:
23 May 1989 - 3 July 1989

STUDY AREA:
The cruise track covered approximately 5300 km (2861 nm) in the northwestern Atlantic ocean and Gulf of Maine (Fig. 1).

PORTS OF CALL:

Woods Hole, Massachusetts	23 May 1989
St. Georges, Bermuda	31 May - 3 June 1989
Shelburne, Nova Scotia	17 June - 19 June 1989
Gloucester, Massachusetts	24 June 1989
Appledore Island, Maine	24 June - 25 June 1989
Woods Hole, Massachusetts	3 July 1989

SCIENTIFIC PROGRAM:

Summary
- 129 Oceanographic stations
- 73 Bathythermographs
- 24 Surface stations

Physical oceanography
- 14 Conductivity-temperature-depth (CTD) measurements
- 23 Hydrocasts
- 73 Bathythermographs

Chemical oceanography
- 30 Oxygen analyses
- 42 Phosphate analyses

Biological oceanography
- 143 Chlorophyll *a* analyses
- 6 Phytoplankton-net tows
- 47 Neuston-net tows
- 12 Oblique meter-net tows
- 1 Opening/closing-net tow
- 12 Otter trawls

Geological oceanography
- 31 Shipek sediment grabs
- 7 Fisher-scoop sediment grabs
- 2 Gravity cores
- 2 Rock dredges

PARTICIPANTS:

<u>Nautical staff</u>

Ron Harelstad	Captian
Greg Lohse	First Mate
Mark Crutcher	Second Mate
Laura Norris	Third Mate
Beccy Grundy	Steward
Gioia Blix	Engineer

<u>Scientific staff</u>

Bill Corso	Chief Scientist
Ingrid Smith	First scientist
Steve Hilger	Second scientist
Adam Brunet	Third scientist

<u>Students</u>

Rebecca Arenson	Carleton College
Ginny Eckert	Dartmouth College
Kirsten Evans	University of California, Santa Cruz
Cait Goodwin	Connecticut College
Gretchen Holschuh	University of New Hampshire
Elizabeth J. Osgood	Connecticut College
Hannah Parker	Yale University
Betsy Perry	Vanderbilt University
Jill L. Pudlinski	Colgate University
Scott Putnam	Dartmouth College
Kate Seaver	Sarah Lawrence College
Marie Surprenant (Leg 1)	Lesley College
Kathy Witherell	Dickinson College
Jen C. Zamon	Cornell University

<u>Alumni</u>

Ben Ames	W-105
Andy Bess	C-105
Janet Fordunski	W-105
Jane Hutchinson	W-105
Charlie Jenkins	C-105
Laura Taylor	C-103

<u>Vistors</u>

Jackie Ciano	23 May - 3 July 1989
Lee Richardson	24 June - 3 July 1989
Rafe Parker	25 June - 3 July 1989
Rachel Parker	25 June - 3 July 1989
Tom Trull	25 June - 3 July 1989
Jim Brzezinski	25 June - 3 July 1989

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Geological Oceanographic Studies

INTRODUCTION

This cruise report outlines the scientific research program conducted from the SSV CORWITH CRAMER during Sea Education Association's Sea Semester 106. The cruise traversed much of the northwestern Atlantic ocean (Fig. 1; see Appendix 1 for a list of midnight and noon positions), and a variety of biological, chemical, physical, and geological investigations were done (see Appendix 2 for a list of oceanographic station locations). These investigations represented both individual student research projects, which had been designed by the students prior to the cruise, and on-going studies of SEA staff scientists and associated agencies. Abstracts of the student research projects make up the major part of this report. These abstracts are edited versions of those written at sea and are not intended to reflect the final analysis or interpretation of data collected during C-106.

CRUISE SUMMARY

The northwestern Atlantic is an area characterized by diverse hydrographic regions (Fig. 2). During the first leg of cruise C-106 (Woods Hole-Bermuda), the main hydrographic winch aboard Cramer did not work, so our studies focused on the thermal structure of the sea and the neuston zone. We took bathythermographs (BT) approximately every 20 nm (see Appendix 4) and twice-daily neuston net tows (see Appendix 2).

North of the Gulf Stream, there was a complex mix of shelf, slope, and Gulf Stream waters (Fig. 2). The BT data (Appendix 5), when compiled and plotted along our cruise track, indicated that

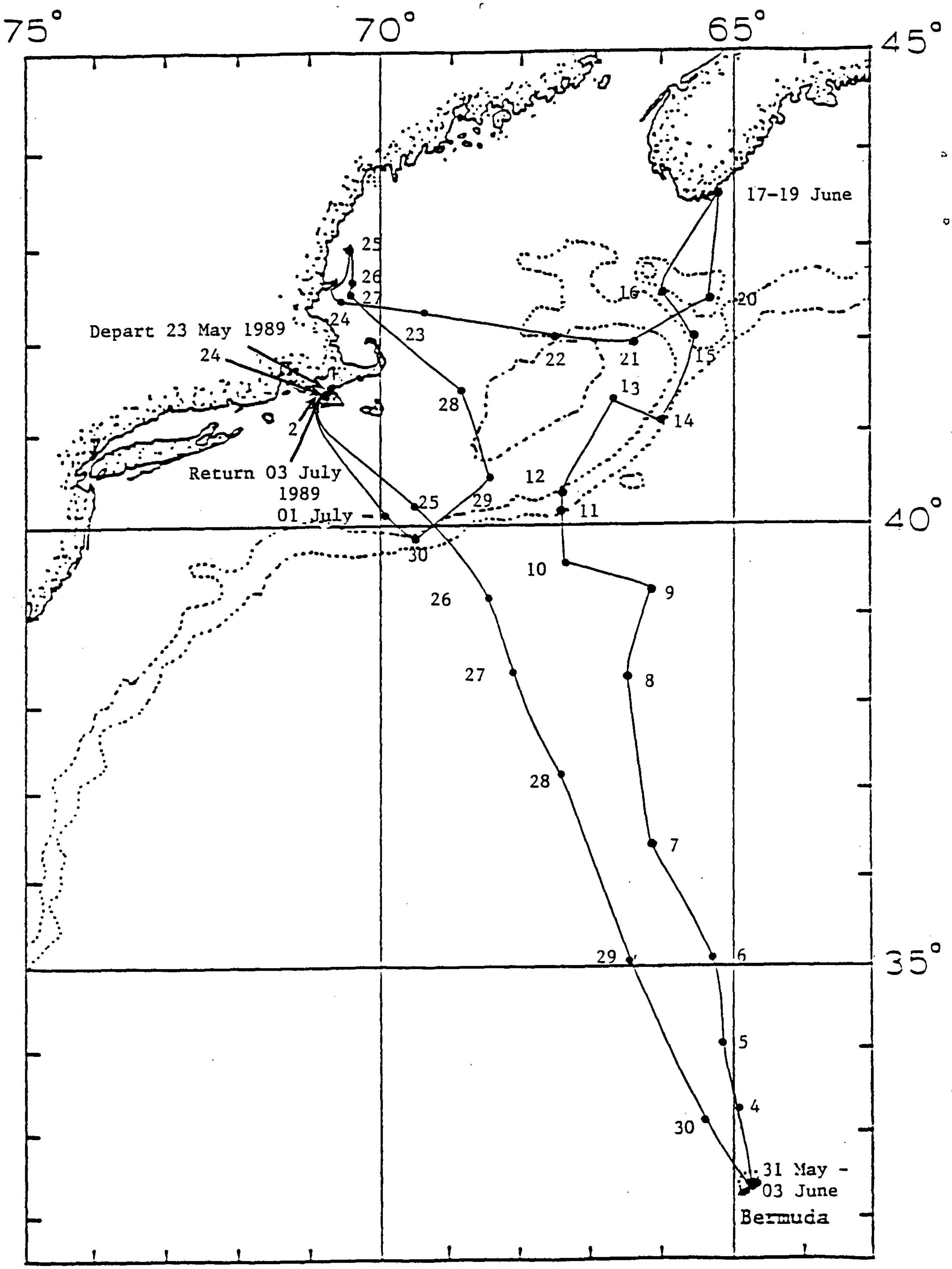


Figure 1. Noon (1200 hours) positions of the SSV CORWITH CRAMER during Sea Education Association cruise C-106.

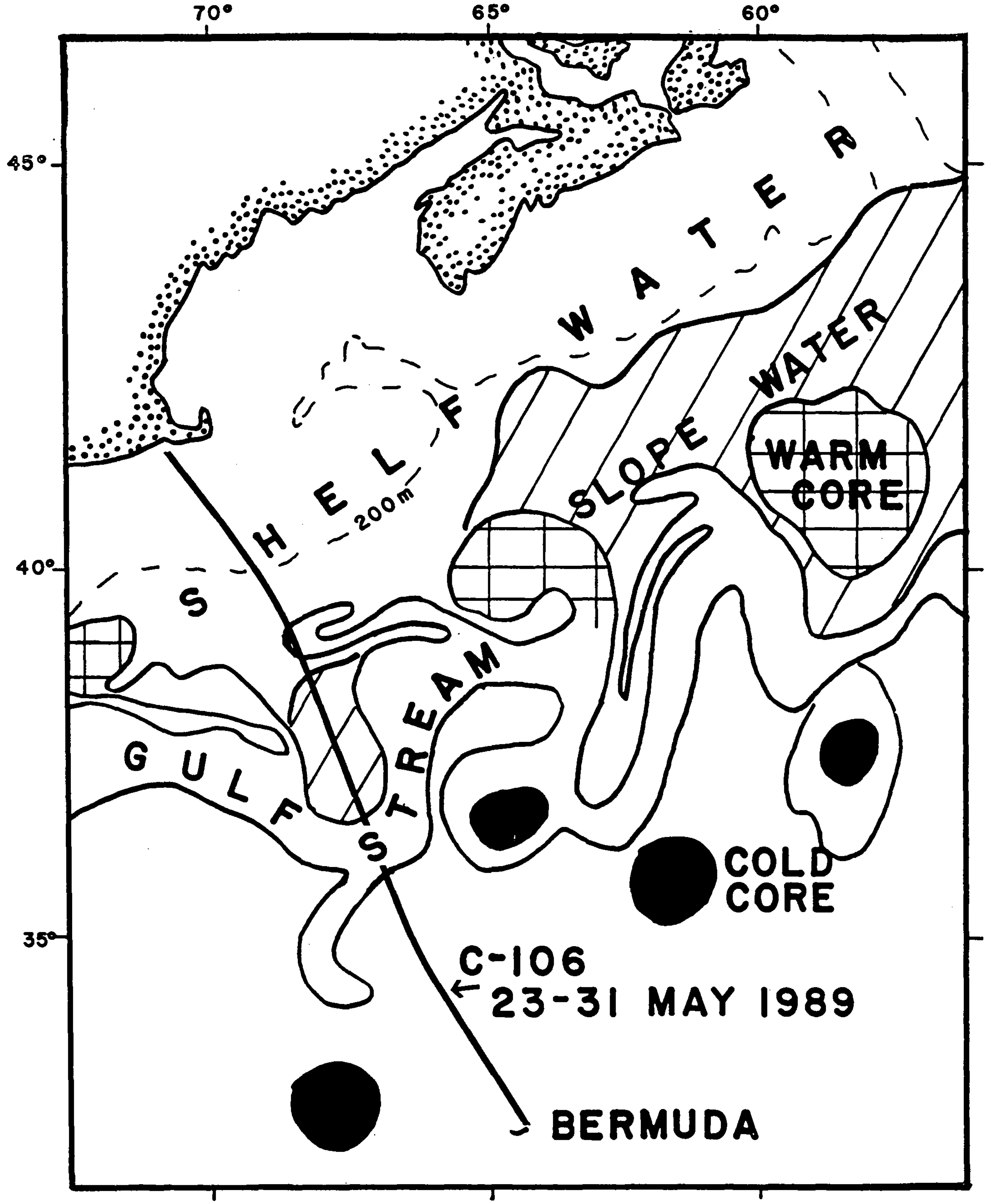


Figure 2. Water mass distribution patterns for 5 June 1989 (modified from Oceanographic analysis, NOAA/National Ocean Service) with C-106 cruise track superimposed.

the thermal front between Georges Bank shelf and North Atlantic slope waters occurred at about 150 nm (Fig. 3). This front formed a major oceanographic boundary where Elizabeth and Cait focused their studies.

The west wall of the Gulf Stream was encountered at about 480 nm (Fig. 3). Scott augmented the BT data with conductivity-temperature-depth (CTD) data on the return leg north (Fig. 1) and attempted to correlate Gulf Stream surface current intensity with its density structure.

Zooplankton biomass in the neuston zone showed two major trends. First, total biomass decreased as we moved south (Fig. 4). Second, neuston biomass was apparently larger during the evening than during the day (Fig. 4), thus substantiating the fact that some marine organisms migrate daily up and down through the water column.

Kate's study of terrestrial insects found in the neuston zone showed a correlation between insect abundance and proximity to continental landmasses. Betsy, on the other hand, focused on that part of the marine food web below zooplankton, namely nutrient supply and phytoplankton. She documented a steady decrease of both from shelf to northern Sargasso Sea waters.

The abundance and distribution of plastics and tar in the neuston zone were investigated by everyone aboard (Fig. 5). Both of these pollutants were more abundant around Bermuda than elsewhere along the cruise track (Fig. 5). This distribution pattern reflected the concentration of flotsam within the central part of the North Atlantic gyre.

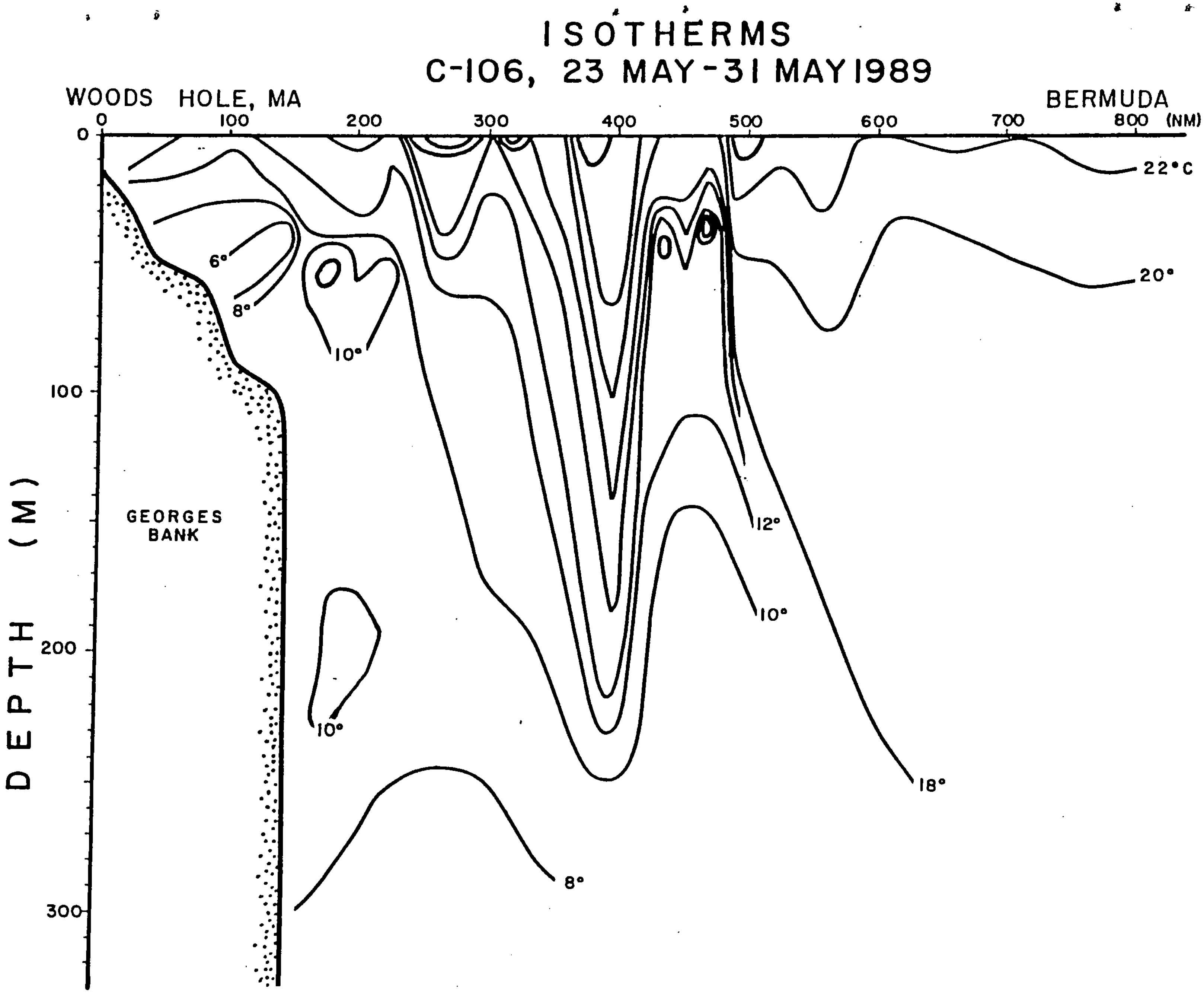


Figure 3. Isotherms (based on bathythermograph stations, see Appendices 4 & 5, and hourly surface temperatures) from Woods Hole, Massachusetts, to St. Georges, Bermuda, during 23 May - 31 May 1989.

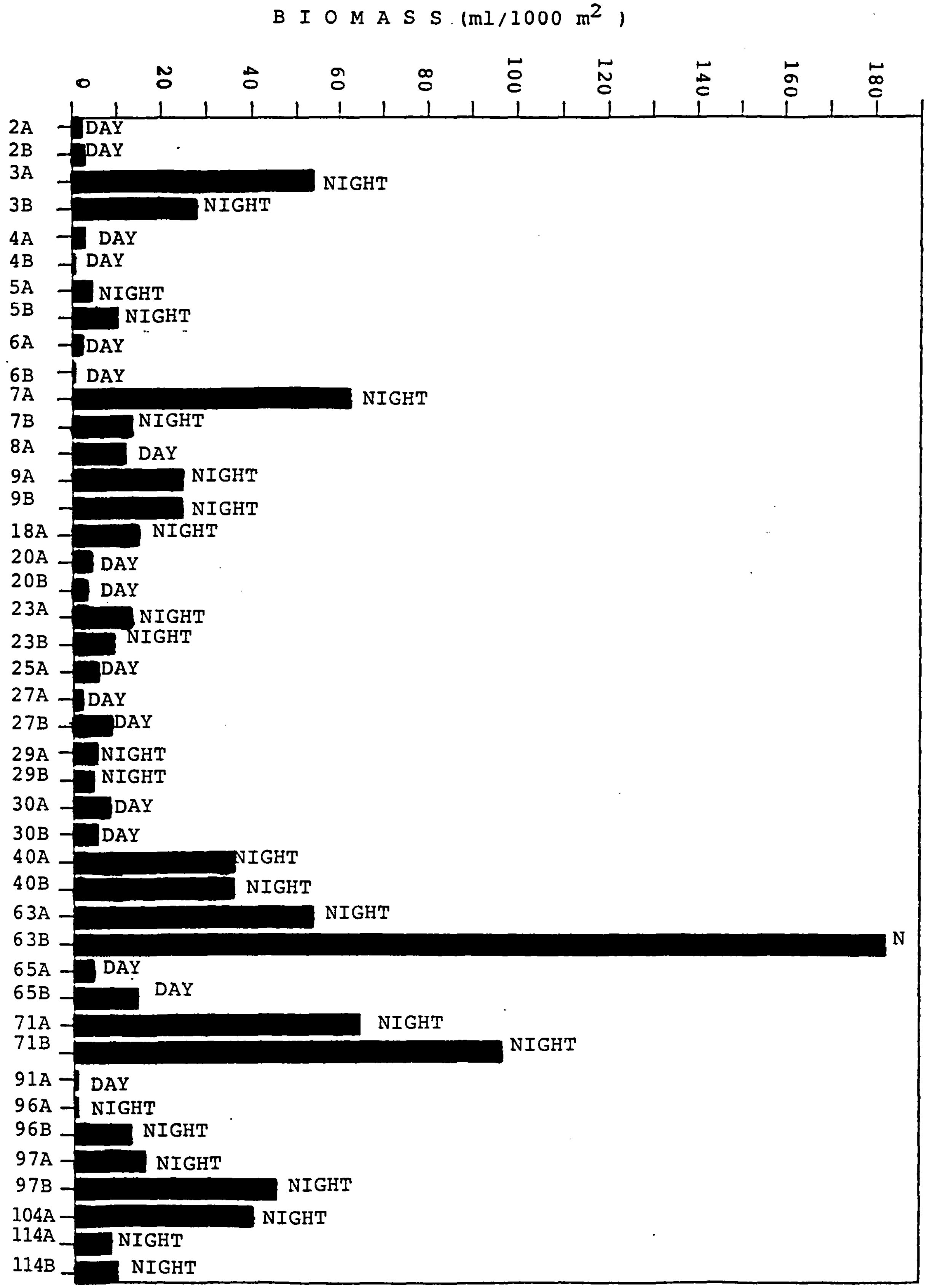


Figure 4. Zooplankton biomass (ml/1000 m^2) in neuston net tows (see Appendix 2 for specific station locations). Time of day for each tow is also shown (day=noon, night=midnight).

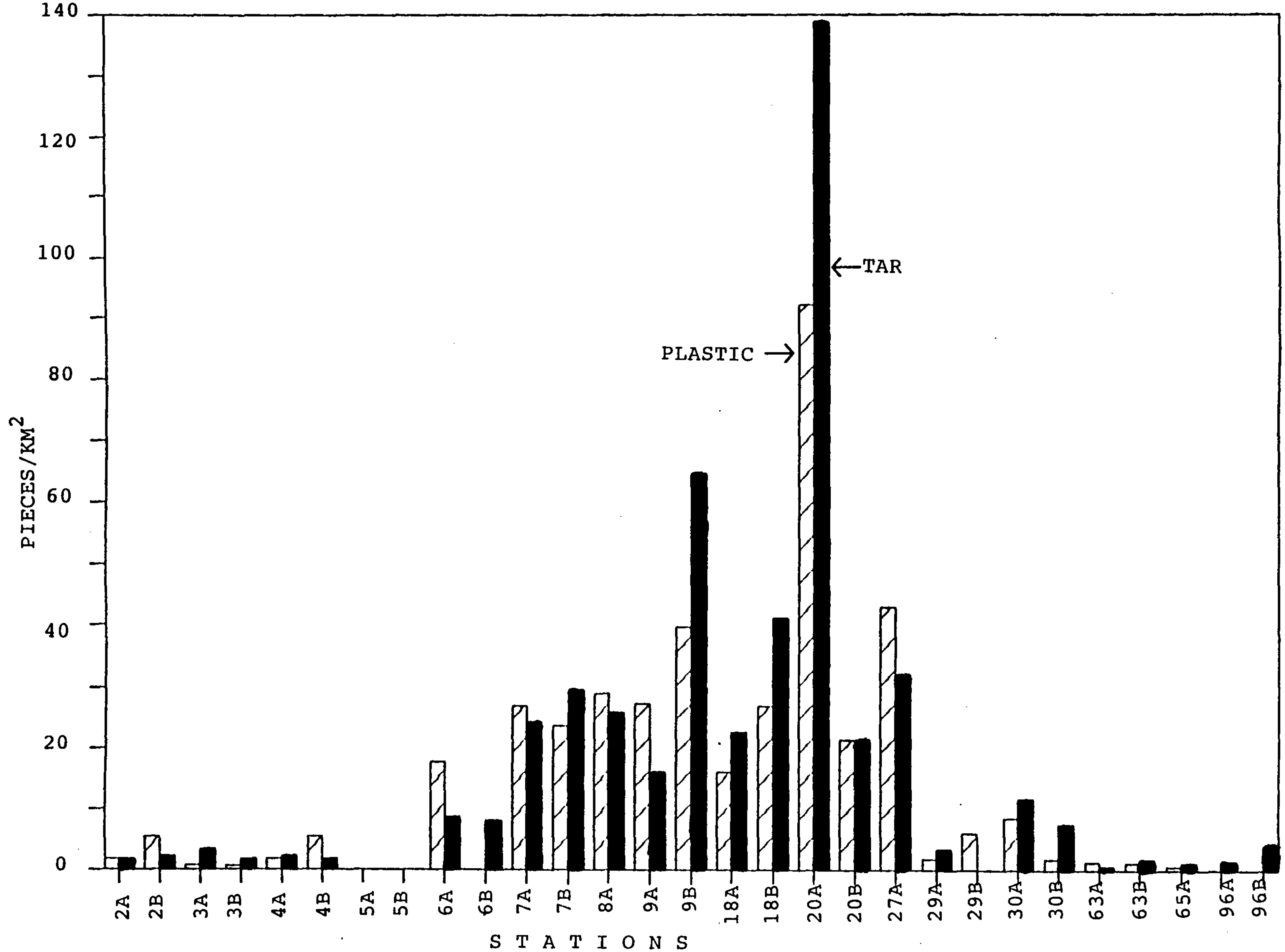


Figure 5. Plastic and tarball densities in neuston net tows (see Appendix 2 for specific station locations).

Following our port stop in Bermuda, where the winch was repaired, our research efforts focused on the majority of individual research projects that required deep-water data. Jill investigated the types of sediments found on Bermuda's shelf and slope. Rebecca probed, sometimes in vain, Bear Seamount, while Hannah spent several sleepless nights counting bioluminescent flashes. Kirsten had everyone pumped-up as they filtered water to determine chlorophyll a concentrations in net, nanno, and pico-plankton.

Once on Georges Bank, we concentrated our efforts on fishing and the sea floor. Gretchen and Ginny did not let a cod get by without first looking at it for diseases and counting it. Jen concentrated on the distribution of zooplankton on the bank, then on just six types of organisms on the bank, and finally on amphipods and euphausiids. Kathy looked at the mineral assemblages in sediments from Lydonia and Corsair canyons.

During the last leg (Shelburne to Woods Hole), we continued to trawl on Georges Bank, as well as Browns and Stellwagen Banks. On 20 June, we encountered approximately 20-30 right whales near Browns Bank (see Jackie's report on marine mammal activity), and stayed with them, observing and photographing their behaviors, for the entire day. On 24 June, we stopped at the Shoals Marine Lab, where we were treated to a field trip through a rocky intertidal zone, led by Dr. Art Borror, fish dissections, led by Dr. Ric Martini, a talk on sharks by Ric, and a legendary party. After we left the lab, we concentrated on analyzing all of the data that we had collected during the cruise, and arrived back in Woods Hole on 3 July.

MARINE MAMMAL ACTIVITY
by Jackie Ciano, New England Aquarium

The cruise track of C-106 provided a fantastic opportunity for me, as a researcher with the New England Aquarium's North Atlantic right whale project, to assess marine mammal activities in the northwestern Atlantic, including an area (i. e., between Bacarro and Browns Bank) frequently used by North Atlantic right whales (*Eubalaena glacialis*).

Marine mammals that were observed during the cruise were identified, and photographs were taken when possible. A sighting log was kept and included: species, number of animals, date, time, location, water depth, and surface water temperature (Table 1). Conditions of weather, sea state, and platform logistics (e. g., if the ship was hove to or underway) were recorded separately.

From 23 May until 10 June, I participated in the normal watch routine with B watch. After 10 June, I stood an independent twelve hour day watch in order to document marine mammal activity in areas that had not been surveyed previously as part of the New England Aquarium's North Atlantic right whale project.

Much to my delight, on 15 June 1989, four right whales were sighted in the Fundian/Northeast Channel. They were engaged in a SAG (surface active group) in close proximity to a small fishing vessel and five sei whales. Photo-documentation was obtained, and we spent a good portion of the day observing the behavior of these whales.

Upon leaving Shelburne, Nova Scotia, we sighted no less than ten right whales in one static count in an area east of Browns

CODE

UNDO·UNIDENTIFIED DOLPHIN

WSDO·WHITE-SIDED DOLPHIN

FIWH·FINBACK WHALE

UNBA·UNIDENTIFIED BALEEN WHALE

PIWH·PILOT WHALE

STDO·STRIPED DOLPHIN

CODO·COMMON DOLPHIN

SPWH·SPERM WHALE

RIDO·RISSO'S DOLPHIN

SPDO·SPOTTED DOLPHIN

BASH·BASKING SHARK

HUWH·HUMPBACK WHALE

BODO·BOTTLENOSE DOLPHIN

RIWH·RIGHT WHALE

SEWH·SEI WHALE

MIWH·MINKE WHALE

	DATE	TIME	SPECIES	NUMBER	LATITUDE	LONGITUDE	DEPTH	CENTIGRADE
1	05/24/89	1738	UNDO	2	4104.5	7048.0	35	12.6
2	05/25/89	703	WSDO	30	4020.9	6953.9	73	11.4
3	05/25/89	858	FIWH	1	4018.0	6948.7	73	11.3
4	05/25/89	1641	UNBA	1	4003.7	6925.3	97	12.5
5	05/25/89	2200	UNDO	6	3946.5	6858.6	2000	15.8
6	05/26/89	502	PIWH	13	3934.1	6839.0	3000	13.4
7	05/26/89	752	STDO	300	3928.0	6833.6	3200	13.1
8	05/26/89	1349	CODO	10	3916.4	6836.6	3200	14.9
9	05/26/89	1935	CODO	2	3857.0	6906.0	3500	14.3
10	05/27/89	100	CODO	10	3650.8	6837.6	3600	15.7
11	05/28/89	1624	SPWH	1	3645.4	6723.6	5043	25.6
12	05/29/89	1101	SPWH	3	3507.4	6643.4	5000	22.0
13	05/29/89	1124	UNDO	12	3507.4	6643.4	5000	22.0
14	06/05/89	600	RIDO	6	3404.9	6507.8	5000	24.0
15	06/05/89	630	SPWH	1	3405.6	6508.5	5000	24.0
16	06/06/89	1138	SPDO	9	3503.9	6533.8	4837	23.8
17	06/09/89	945	UNDO	12	3920.5	6606.6	4500	23.1
18	06/09/89	1815	UNDO	50	3943.0	6654.6	3500	16.6
19	06/09/89	1917	BASH	7	3951.0	6719.0	2000	15.3
20	06/09/89	1940	SPWH	1	3946.5	6705.6	2000	15.4
21	06/10/89	1615	CODO	4	3959.9	6722.2	2000	14.9
22	06/10/89	1715	UNDO	12	4001.6	6721.4	2000	14.9
23	06/10/89	1820	SPWH	1	4001.7	6719.9	2000	15.1
24	06/10/89	1916	CODO	4	3958.5	6720.5	2000	14.9
25	06/11/89	807	PIWH	30	4011.7	6735.6	2000	14.0
26	06/11/89	1110	CODO	20	4019.5	6738.8	1000	12.6
27	06/11/89	1311	UNBA	1	4021.5	6737.0	200	12.6
28	06/11/89	1842	SPWH	2	4024.5	6740.1	200	12.6
29	06/12/89	515	CODO	12	4022.9	6735.7	200	13.1
30	06/12/89	545	UNBA	1	4023.0	6733.5	200	12.9
31	06/12/89	708	PIWH	3	4026.0	6735.0	200	12.7
32	06/12/89	1006	CODO	8	4030.7	6738.3	200	12.3
33	06/12/89	1220	CODO	2	4033.1	6734.7	90	12.1
34	06/12/89	1555	CODO	6	4047.8	6721.6	80	12.2
35	06/13/89	1130	HUWH	1	4126.8	6638.2	50	10.1
36	06/14/89	845	UNDO	5	4120.6	6608.7	90	13.5
37	06/14/89	1919	PIWH	30	4120.9	6606.8	200	13.7
38	06/14/89	1919	BODO	30	4120.9	6606.8	200	13.7
39	06/15/89	1012	RIWH	4	4211.2	6543.0	206	11.5
40	06/15/89	1012	SEWH	5	4211.2	6543.0	296	11.5
41	06/15/89	1415	UNDO	6	4219.6	6543.3	93	11.3
42	06/15/89	1655	MIWH	1	4229.8	6546.9	93	10.5
43	06/15/89	1855	UNDO	3	4237.9	6550.7	93	10.7
44	06/16/89	830	FIWH	1	4250.6	6610.4	29	10.2
45	06/20/89	854	RIWH	2	4305.1	6511.6	91	10.0
46	06/20/89	926	RIWH	1	4303.4	6511.6	94	10.3
47	06/20/89	1312	RIWH	10	4255.4	6515.2	87	12.6
46	06/20/89	1417	FIWH	100	4256.3	6514.9	87	12.6
49	06/20/89	1542	RIWH	5	4255.8	6516.0	87	13.4
50	06/20/89	1634	RIWH	5	4254.1	6518.9	60	13.5
51	06/20/89	1806	WSDO	8	4248.1	6531.6	75	13.2
52	06/21/89	410	FIWH	4	4224.9	6633.1	274	13.8
53	06/23/89	1020	MIWH	1	4227.4	6104.9	120	18.1
54	06/26/89	1225	RIDO	1	4249.2	7017.8	33	19.3
55	06/26/89	1333	MIWH	1	4253.3	7007.2	33	18.3
56	06/26/89	1450	HUWH	2	4254.2	7008.3	33	17.6
57	06/26/89	1450	WSDO	10	4254.2	7008.3	33	17.6
58	06/26/89	1630	FIWH	1	4254.0	7009.4	33	17.0
59	06/27/89	530	HUWH	8	4226.2	7022.7	22	17.0
60	06/27/89	615	FIWH	1	4226.1	7022.8	22	16.7
61	06/27/89	645	MIWH	1	4226.5	7022.9	22	14.8
62	06/27/89	655	HUWH	4	4226.3	7023.1	22	14.8
63	06/27/89	1115	HUWH	1	4224.7	7025.0	13	18.2
64	06/27/89	1130	HUWH	2	4224.0	7024.9	13	19.0
65	06/27/89	1340	HUWH	1	4217.5	7019.2	16	19.8
66	06/27/89	1542	HUWH	1	4219.8	7018.6	13	18.8
67	06/27/89	1632	FIWH	2	4219.5	7013.9	27	18.0
68	06/29/89	845	PIWH	7	4107.0	6819.9	6	12.7
69	06/29/89	942	PIWH	2	4103.3	6817.1	8	12.4
70	06/30/89	500	UNDO	10	4002.3	6907.4	200	16.9
71	06/30/89	715	RIDO	10	3956.4	6916.8	432	19.4
72	06/30/89	1154	PIWH	75	3949.5	6929.7	1500	23.5
73	06/30/89	1245	BODO	4	39485.0	6928.4	1500	23.8
74	06/30/89	1425	RIDO	4	3950.5	6933.0	1000	23.5
75	06/30/89	1600	PIWH	100	3951.4	6936.6	1000	21.8
76	06/30/89	1943	UNDO	5	3953.3	6945.6	700	20.0
77	07/01/89	600	UNDO	7	3952.6	6946.8	1000	18.3
78	07/01/89	900	FIWH	1	3959.8	6954.2	200	18.4
79	07/01/89	1200	CODO	500	4006.9	6958.8	97	18.5
80	07/01/89	1715	PIWH	25	4017.1	7003.9	80	19.4
81	07/01/89	1715	CODO	10	4017.1	7003.9	80	19.4

Table 1. Marine mammal and other large fish observations.

Bank on 20 June 1989! With camera shutters clicking, and students assisting in taking whale respiration data, we spent the entire day surveying this general area. Between 0900 and 1630 hours, we sighted approximately 18 to 27 individual right whales, which represented approximately one tenth of the known population! Until photo-analysis is completed, however, I will not be sure of exactly how many individuals were sighted.

My thanks to the captain, crew, and students of class C-106. These valuable data will be incorporated into the New England Aquarium's North Atlantic right whale project database and further our knowledge of this most endangered of whales.

STUDENT PROJECT ABSTRACTS

Physical Oceanographic Studies

Gulf Stream Density Structure and Surface Currents
by Scott Putnam

Five conductivity-temperature-depth (CTD) profiles were taken during 8 June - 9 June 1989 in a southeast-northwest trending transect across the Gulf Stream to determine the temperature, salinity, and density structure of the Gulf Stream down to approximately 1000 m. In addition, set and drift calculations for the SSV Corwith Cramer were done every half hour to measure surface currents. These data tested my hypothesis that surface current intensity was directly related to density structure.

The CTD data provided a two-dimensional profile of the physical characteristics of the Gulf Stream. The west wall of the Stream had steep temperature and density gradients, while the eastern edge of the Stream was less defined (e. g., the 15 $^{\circ}$C isotherm was relatively flat along the eastern edge but rose approximately 500 m across a distance of 20 nm along the western wall). The salinity data also had a sharp gradient along the western wall and no clearly defined trend along the eastern edge of the stream.

Surface drift values within the Gulf Stream ranged from approximately 50 cm/sec to 700 cm/sec with mean values at the five CTD stations between 100-300 cm/sec. The set was consistently eastward.

There was no apparent correlation between surface drift and the density structure of the Gulf Stream. I believe this primarily reflected errors introduced in the drift calculations, and recommend that future studies try to estimate surface currents with a method other than the set and drift of the vessel.

The Local Effect of Bear Seamount on Current and Sedimentation Patterns

by Rebecca Arenson

Bear Seamount is part of the New England Seamount chain and is located at 67° 25' W, 39° 35' N, just south of Georges Bank. The seamount rises up approximately 1000 m from the surrounding sea floor, which is 2200 m deep. I hypothesized that the seamount's topography would influence deep-water circulation patterns and consequently local sedimentation patterns. To test this hypothesis, we took a total of five conductivity-temperature-depth (CTD) measurements and four sediment grabs from around the seamount and its top. In addition, we ran a series of

3.5 kHz precision depth recorder (PDR) profiles over the seamount to map its bathymetry.

Deep temperature and salinity data (i. e., greater than 500 m) were characteristic of North Atlantic slope water (i. e., 3.5-5.0 ^{o}C and 34.9-35.0 parts per thousand), and there was no evidence to suggest that Bear Seamount perturbed normal temperature, salinity, or density gradients. Moreover, the PDR profiles did not show any evidence of current scouring (e. g., a moat at the base of the seamount) or regions of preferential sediment deposition and nondeposition.

A strong, deep-water current on the eastern and northeastern flanks of the seamount was suggested, however, by the deployment of both the CTD and sediment grab. Based on the maximum recorded depth of the CTD and wire out, there appeared to be a current induced wire angle of 40 degrees. Futhermore, only two of the four sediment grabs reached bottom and recovered fine foraminiferal sand. The two that did not reach bottom were deployed in water depths of approximately 2200 m, but more than 3000 m of wire was payed out each time. This suggested that there was a current induced wire angle greater than 43 degrees.

Chemical Oceanographic Studies

Phosphate and Chlorophyll a Concentrations from Georges Bank to the Northern Sargasso Sea
by Betsy Perry

Phosphate and chlorophyll a concentrations were determined for 24 surface water samples, which were collected from Georges Bank shelf, slope, Gulf Stream, and northern Sargasso Sea hydrographic regions during 23 May - 9 June 1989. In addition to the surficial water samples, the vertical distribution of phosphate and chlorophyll a concentrations were determined for the upper 200 m in both the Gulf Stream and northern Sargasso Sea. All of these data addressed two questions: 1) was there a causal relationship between phosphate concentrations and primary production, as measured by chlorophyll a concentrations; and 2) were seasonal depletions in both nutrient supply and primary production north of the Gulf Stream more pronounced than less seasonally affected nutrient and chlorophyll a concentrations south of the stream?

In both shelf and slope surface waters, phosphate and chlorophyll a concentrations followed similar trends, suggesting a causal relationship between the two. Both started out relatively high in shelf water (phosphate-0.04 uM/l, chlorophyll a-0.26 ug/l), then decreased (phosphate-0.03 uM/l, chlorophyll a-0.24 ug/l) before reaching maxima in slope water (phosphate - 0.05 uM/l, chlorophyll a-0.42 ug/l).

In northern Sargasso Sea surface water, phosphate and chlorophyll a trends were inversely related and did not suggest any type of causal relationship. This trend contrasted with the vertical distribution patterns of phosphate and chlorophyll a, which did appear to follow similar trends; both reaching maximum values at about 80 m (phosphate-0.04 uM/l, chlorophyll a-0.07 ug/l).

In the Gulf Stream, both phosphate and chlorophyl a values remained relatively constant throughout the upper 200 m (phosphate-0.02 uM/l, chlorophyll a-0.01 ug/l).

Both phosphate and chlorophyll a concentrations in shelf and slope surface waters were higher than Gulf Stream and northern Sargasso Sea values, suggesting that even though shelf and slope nutrients and primary producers were seasonally depleted, they were still higher than the more temporally constant values in the Gulf Stream and northern Sargasso Sea.

Oxygen, Phosphate, and Copper Concentrations on Three North Atlantic Banks and Their Effects on Demersal Fish Viability
by Ginny Eckert

This study evaluated the effects of chemical pollution, as measured by oxygen, phosphate, and copper analyses, on the health of dermersal fish at Georges Bank, Browns Bank, and Stellwagen Bank. Water samples were collected approximately 20 m above the sea floor at seven hydrocast stations (three on Georges Bank, one on Browns Bank, and three on Stellwagen Bank). In conjuction with these hydrocasts, 12 otter trawls (eight on Georges Bank, three on Browns Bank, and one on Stellwagen Bank) were done. All bony fish collected were visually inspected for external signs of disease (e. g., fin rot or tumors).

The oxygen and phosphate concentrations were similar among the three banks, ranging from 7.69 to 8.72 ml/l and 0.08 to 0.11 uM/l, respectively. Copper concentrations were low on Georges Bank (about 1 ug/l), unmeasurable on Browns Bank, and highest on Stellwagen Bank (2.49 and 4.48 ug/l).

Fish were caught in only five of the otter trawls on Georges Bank, and no fin rot or epidermal tumors were observed on any of these fish.

The high copper concentrations found on Stellwagen Bank probably reflected anthropogenic input, because the water samples were taken within an industrial dump site located on the bank. Because no fish were collected from either Browns or Stellwagen banks, a comparison of fish health among the banks was not possible.

Biological Oceanographic Studies

A Comparative Study of Surficial Bioluminescence and Dinoflagellates in Northern Sargasso Sea, Gulf Stream, and Georges Bank Shelf Waters
by Hannah Parker

Surficial bioluminescence is produced by some plants, primarily dinoflagellates, and animals when they emit tiny flashes of chemically produced light. The cruise track of C-106 traversed a variety of water masses, and I hypothesized that the amount of surficial bioluminescence would vary in these different water masses because of the different populations of plants and animals within each hydrographic region.

Surficial bioluminescence was analyzed at five nighttime stations during 9 June - 16 June 1989 in the northern Sargasso Sea, Gulf Stream, and on Georges Bank. The moon had set or was not visible during all five stations. Bioluminescence was quantified using three flash-counting methods: 1) scraping a spatula across a 63 micron sieve, through which surface water had passed; 2) agitating a bucket of sea water with an egg beater; and 3) observing flashes in the cod-end jar of a 63 micron mesh net, after towing the net at the surface for 15 minutes. In addition, the net samples were analyzed microscopically to determine both the composition of the biomass and dinoflagellate abundance.

Both the flash counts and biomass analyses showed striking differences in the amount of measurable surficial bioluminescence and dinoflagellate abundances in the three water masses. The stations in the northern Sargasso Sea exhibited lower flash counts (average scrape count of 10.3 flashes) and dinoflagellate abundance (19.0% of total biomass) than stations in the Gulf Stream (19.1 flashes, 44.6% of total biomass) and on Georges Bank (52.2 flashes, 83.2% of total biomass).

In all water masses, three species of dinoflagellates predominated: 1) Ceratium fusus, 2) Ceratium tricheroceros, and 3) Ceratium longipes.

Since the number of flashes increased at the stations where the relative number of dinoflagellates increased, there is probably a causal relationship between measurable surficial bioluminescence and dinoflagellate abundance.

The Relative Abundances of Net, Nanno, and Pico Phytoplankton in Three North Atlantic Water Masses
by Kirsten Evans

Vertical profiles (from the sea surface to about 150 m) of the standing crop of three size fractions (greater than 20 um, 20-5 um, and 5-0.22 um) of phytoplankton were determined using chlorophyll a analyses for Georges Bank shelf, Gulf Stream, and northern Sargasso Sea waters. In addition to determining chlorophyll a concentrations in each size fraction, phaeopigment concentrations were calculated and used as an indicator of the quantity of dead and decomposing phytoplankton in the water sample.

Generally in all three water masses, the chlorophyll a concentrations in the greater than 20 um size fraction (net phytoplankton) were the largest of the three size fractions. The values ranged from 0.02 to 4.29 ug/l, as compared to the range of values for nanno phytoplankton (0.01 - 0.40 ug/l) and pico phytoplankton (0.01 - 0.08 ug/l). The highest concentrations in each size fraction occurred in Georges Bank shelf water.

Vertical trends in each size fraction did not always mimic each other, suggesting that different factors affected the distribution of each size fraction (e. g., settling rates, rates of decomposition).

In each water mass, and within each size fraction, there was a deep chlorophyll maximum (DCM) associated with the thermocline. The DCM also had the highest phaeopigment concentrations, suggesting that the DCM consisted of degraded phytoplankton cells.

Chlorophyll a Concentrations at the Thermal Front Between Georges Bank Shelf and Slope Water Masses

by Elizabeth Jo Osgood

A thermal front exists along the southern edge of Georges Bank where cooler, less saline shelf water abuts warmer, more saline slope water. This type of thermal front is typically associated with vertical mixing and high biological activity; therefore, this study focused on the vertical distribution of chlorophyll a (sea surface to about 80 m) across the thermal front in order to characterize primary production associated with the front.

Mechanical bathythermograph (MBT) data and water samples for chlorophyll *a* analyses were collected along two transects near Lydonia and Corsair canyons. Temperature data were collected approximately every two nautical miles, while 36 chlorophyll *a* analyses were done from depths of 0, 1, 20, 40, and 80 m at a total of eight hydrocast stations.

Upon graphing the isotherms from the MBT data and calculating average chlorophyll *a* concentrations for each hydrocast station, a much more complex profile was found than expected. Rather than one chlorophyll *a* peak at the thermal front as anticipated, three peaks occurred. Passing from the slope onto the shelf, peaks were located at the thermal front (0.75 ug/l), at the head of Lydonia Canyon (0.84 ug/l), and on Georges Bank itself (2.75 ug/l).

Vertically, the average chlorophyll *a* concentrations at each station peaked at 20 m, which correlated with a deep chlorophyll maximum (DCM) identified by Evans (this report).

Zooplankton Biomass at the Thermal Front along the Southern Flank of Georges Bank
by Cait Goodwin

Along the southern flank of Georges Bank, relatively cool, fresh shelf water converges with warm, saline slope water and forms a thermal front, whose location typically corresponds with the bathymetric shelf-slope break. Because of vertical mixing, high productivity associated with the front, and the daily migration habits of surface-feeding slope populations of zooplankton, I expected to find a high zooplankton biomass associated with the thermal front. To test this hypothesis, vertical temperature profiles were taken approximately every two nautical miles along two transects in Lydonia and Corsair canyons. In addition, two oblique multi meter-net tows were done in Lydonia Canyon and three tows were done in Corsair Canyon. Combined, these two sets of tows and temperature data form a composite transect across the southern edge of Georges Bank.

The isotherms indicated that the thermal front was situated between the 100 m and 200 m contours.

The average zooplankton biomass for each station along the composite transect were: 1) 560 ml/1000 m^3 in 100 m of water, 2) 910 ml/1000 m^3 in 130 m of water, 3) 20 ml/1000 m^3 in 200 m of water, 4) 90 ml/1000 m^3 in 640 m of water, and 5) 250 ml/1000 m^3 in 840 m of water. These values represented the transition from shelf to slope water masses, and show that the highest biomass occurred just shelfward of the thermal front.

Amphipods as Indicator Species for Georges Bank Shelf, Wilkinson Basin, and Eastern Slope Water Masses

by Jen Zamon

Six amphipod species were analyzed in seven oblique meter-net tows conducted in Georges Bank (GB), Wilkinson Basin (WB), and eastern slope (SL) waters to determine both population sizes within each hydrographic region and water mass interactions. GB water is formed by the mixing of WB and SL waters in a ratio of 95:5; therefore, I hypothesized that the distribution patterns of zooplankton within these water masses would reflect similiar mixing ratios.

Two of the tows were done in GB water, two in SL water, and three in WB water. All of the nets were towed approximately three quarters of the way through the water column in each hydrographic region.

Six amphipod species were identified: 1) _Ampithoe sp._, 2) _Hyperia galba_, 3) _Lembos or Microdeutopus sp._, 4) _Parathemisto absyssorium_, 5) _Parathemisto gaudicauchii_, and 6) _Parathemisto libellula_. Only _H. galba_ and _P. abyssorium_ were present in all three water masses. The average abundances (individuals/1000 m^3) for _H. galba_ in GB, WB, and SL waters were 937, 45, and 198, respectively. For _P. abyssorium_, they were 20, 33, and 158, respectively.

The _P. abyssorium_ data support my hypothesis, while the _H. galba_ data do not. This could be explained by the intrusion and greater mixing of SL water along the southern and eastern edges of Georges Bank.

The Distribution of Terrestrial Insects Found Among Marine Zooplankton Populations
by Kate Seaver

This study examined the distribution of terrestrial insects found within the zooplankton biomass collected in neuston net tows along the entire cruise track of C-106. Terrestrial insects were initially separated from marine organisms, then they were volume displaced, and finally, individual insects were identified, measured, and counted.

A total of 47 neuston net tows were done, and only nine of these tows recovered terrestrial insects. The largest insect biomass (8000 ml/1000 m^3) occurred within 150 nm of the continental United States and Canada, and comprised only 9% of the total zooplankton biomass. The types of insects found were beetles, bees, flies, mosquitoes and moths. These data contrasted with tows from around the island of Bermuda, where the insect biomass was only about 500 ml/1000 m^3 within 60 nm of shore and comprised only about 1-2% of the total zooplankton biomass. Here, only small flies were found.

These data suggested that geographic location (e. g., proximity to a continental landmass) primarily influenced the abundance of terrestrial insects found within marine zooplankton.

The Relationship Between Sea Floor Sediment Size and Demersal Fish Habitat
by Gretchen Holschuh

The relationship between sea floor sediment size and demersal fish habitat on the southeast, south-central, and northern regions of Georges Bank was investigated in this study by taking sediment samples from each area followed by an otter trawl. Sediment size fractionation was determined by seiving the sample through a series of seives (4, 2, 1, 0.500, 0.250, 0.125 mm). All demersal fish caught in an otter trawl were identified and counted.

On the southeastern edge of Georges Bank, the sea floor sediment was characterized by medium grain sand (0.250 mm). The otter trawl recovered an abundance of squirrel hake, skates, and sea robins, although hake are generally thought to be indigenous to a finer grain habitat.

In the south-central part of the bank, the sediment was very coarse sand (1 mm), and two otter trawls were fished. In both, white hake and sea robins predominated, once again apparently contradicting the generally preferred habitat of mud and fine sand for hakes.

Along the northern edge of the bank, the sea floor was a coarse sand (0.500 mm), and squirrel hakes were the most abundant fish. The apparent correlation between hake and relatively coarse sand bottoms at all three study areas suggested that these fish may be changing their preferred habitat because of fishing pressures, food availability, or they were just passing through an area.

Geological Oceanographic Studies

The Mineralogy of Sediment from Lydonia and Corsair Canyons
by Kathy Witherell

The mineralogy of sediments from Lydonia and Corsair canyons, two submarine canyons along the southern edge of Georges Bank, was investigated in this study by microscopic analysis of various sediment size fractions (i. e., 4, 2, 1, 0.500, 0.250, and 0.125 mm). A total of nine samples were recovered from both canyons, including samples from both canyon walls and axes.

Quartz predominated all size fractions, ranging from about 75-95% of the total sample. Opaque minerals (e. g., hematite) were the second most abundant mineral group in all but one sample (4-15 %). Other, minor minerals included: micas, feldspars, and biogenic tests (e. g., foraminifera).

Overall, the sand size fraction (i. e., greater than 0.125 mm) tended to have more of a variety of minerals and rock fragments than the less than 0.125 mm fraction. These abundances suggested that the fine grain mineral assemblages were more uniformly distributed in the canyons around Georges Bank, as contrasted to the coarse grain mineral assemblages.

Bermuda Shelf and Slope Sediment Grain Size and Composition by Jill Pudlinski

To characterize sediment grain size and composition on the Bermuda shelf and slope, seven samples were collected with a sediment grab (four from the shelf, three from the slope). These samples were sieved through a series of sieves (4, 2, 1, 0.500, 0.250, 0.150, and 0.125 mm), and the various size fractions were weighed and inspected microscopically.

The mean grain size of shelf sediments was bimodal (0.150 and 1 mm), while the mean grain size of slope sediments was also bimodal (1 and 4 mm). Both shelf and slope sediments consisted primarily of foraminifera, mollusc fragments, and coral fragments.

The apparent coarsening of sediments downslope probably reflected the relative abundance (45-55%) of large coral fragments (greater than 1 mm) in all three slope samples. It is uncertain if this coral debris is Recent or older deposits associated with sea level changes.

APPENDIX 1. Midnight and noon positions.

DATE	TIME	LOG (nm)	LAT (N)	LONG (W)
24-May-89	0000	Dockside, Woods Hole, Mass.		
24-May-89	1200	"	"	" "
25-May-89	0000	68.1	40.39	70.27
25-May-89	1200	111.8	40.16	69.43
26-May-89	0000	169.0	39.43	68.51
26-May-89	1200	190.5	39.21	68.29
27-May-89	0000	253.7	38.53	68.47
27-May-89	1200	324.4	38.35	68.09
28-May-89	0000	375.2	38.15	67.11
28-May-89	1200	455.5	37.13	67.43
29-May-89	0000	543.0	35.55	67.17
29-May-89	1200	602.9	35.06	66.42
30-May-89	0000	640.7	34.39	66.12
30-May-89	1200	717.0	33.26	65.43
31-May-89	0000	774.5	32.47	65.08
31-May-89	1200	At Anchor, St. Georges, Bermuda		
01-Jun-89	0000	" "	"	" "
01-Jun-89	1200	" "	"	" "
02-Jun-89	0000	" "	"	" "
02-Jun-89	1200	" "	"	" "
03-Jun-89	0000	" "	"	" "
03-Jun-89	1200	" "	"	" "
04-Jun-89	0000	835.6	32.34	64.35
04-Jun-89	1200	874.9	33.38	64.96
05-Jun-89	0000	898.2	33.48	64.57
05-Jun-89	1200	927.2	34.10	65.12
06-Jun-89	0000	946.0	34.23	65.23
06-Jun-89	1200	992.0	35.08	65.36
07-Jun-89	0000	1031.3	35.50	65.48
07-Jun-89	1200	1087.5	36.40	66.13
08-Jun-89	0000	1158.2	37.55	66.10
08-Jun-89	1200	1185.8	38.29	66.26
09-Jun-89	0000	1219.2	39.07	66.23
09-Jun-89	1200	1250.4	39.24	66.06
10-Jun-89	0000	1313.6	39.53	67.21
10-Jun-89	1200	1331.9	39.53	67.27
11-Jun-89	0000	1360.3	39.55	67.25
11-Jun-89	1200	1384.6	40.15	67.37
12-Jun-89	0000	1413.3	40.33	67.43
12-Jun-89	1200	1447.1	40.32	67.35
13-Jun-89	0000	1489.7	41.06	67.01
13-Jun-89	1200	1523.9	41.43	66.61
14-Jun-89	0000	1565.4	41.30	66.23
14-Jun-89	1200	1605.3	41.18	66.03
15-Jun-89	0000	1637.5	41.18	65.55
15-Jun-89	1200	1693.9	42.11	65.43
16-Jun-89	0000	1738.5	42.50	65.45
16-Jun-89	1200	1807.4	42.58	66.04
17-Jun-89	0000	1869.0	43.29	65.10
17-Jun-89	1200	Dockside, Shelburne, Nova Scotia		
18-Jun-89	0000	"	"	" "
18-Jun-89	1200	"	"	" "
19-Jun-89	0000	"	"	" "
19-Jun-89	1200	"	"	" "
20-Jun-89	0000	1898.9	43.27	65.13

20-Jun-89	1200	1925.9	42.58	65.14
21-Jun-89	0000	1981.5	42.44	66.13
21-Jun-89	1200	2039.2	42.06	66.56
22-Jun-89	0000	2076.6	42.26	67.12
22-Jun-89	1200	2128.6	42.20	67.59
23-Jun-89	0000	2170.0	42.10	67.87
23-Jun-89	1200	2249.8	42.45	69.38
24-Jun-89	0000	2302.3	42.38	70.43
24-Jun-89	1200	2321.9	42.55	70.66
25-Jun-89	0000	At Anchor, Appledore Is., Maine		
25-Jun-89	1200	" "	"	" "
26-Jun-89	0000	" "	"	" "
26-Jun-89	1200	2380.1	42.76	70.35
27-Jun-89	0000	2433.5	42.51	70.06
27-Jun-89	1200	2462.7	42.78	70.35
28-Jun-89	0000	2528.6	42.31	69.16
28-Jun-89	1200	2579.5	41.56	68.60
29-Jun-89	0000	2616.6	41.32	68.30
29-Jun-89	1200	2655.9	40.53	68.16
30-Jun-89	0000	2693.9	40.29	69.03
30-Jun-89	1200	2738.5	39.81	69.49
01-Jul-89	0000	2749.9	39.85	69.73
01-Jul-89	1200	2761.2	40.13	69.96
02-Jul-89	0000	2802.7	40.75	70.41
02-Jul-89	1200	At Anchor, Tarpaulin Cove, Mass.		
03-Jul-89	0000	" "	"	" "
03-Jul-89	1200	Dockside, Woods Hole, Mass.		

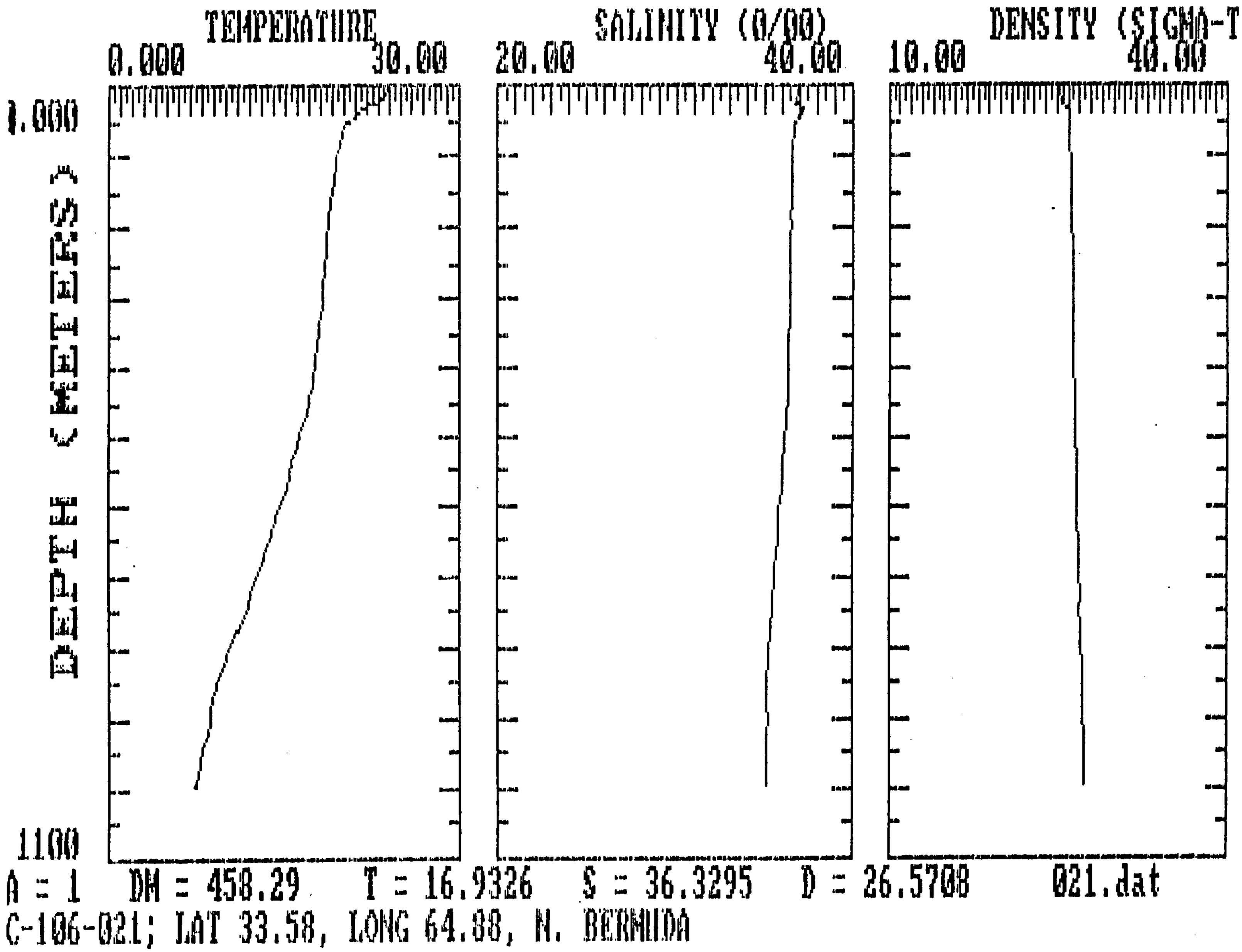
APPENDIX 2. Oceanographic station listing.

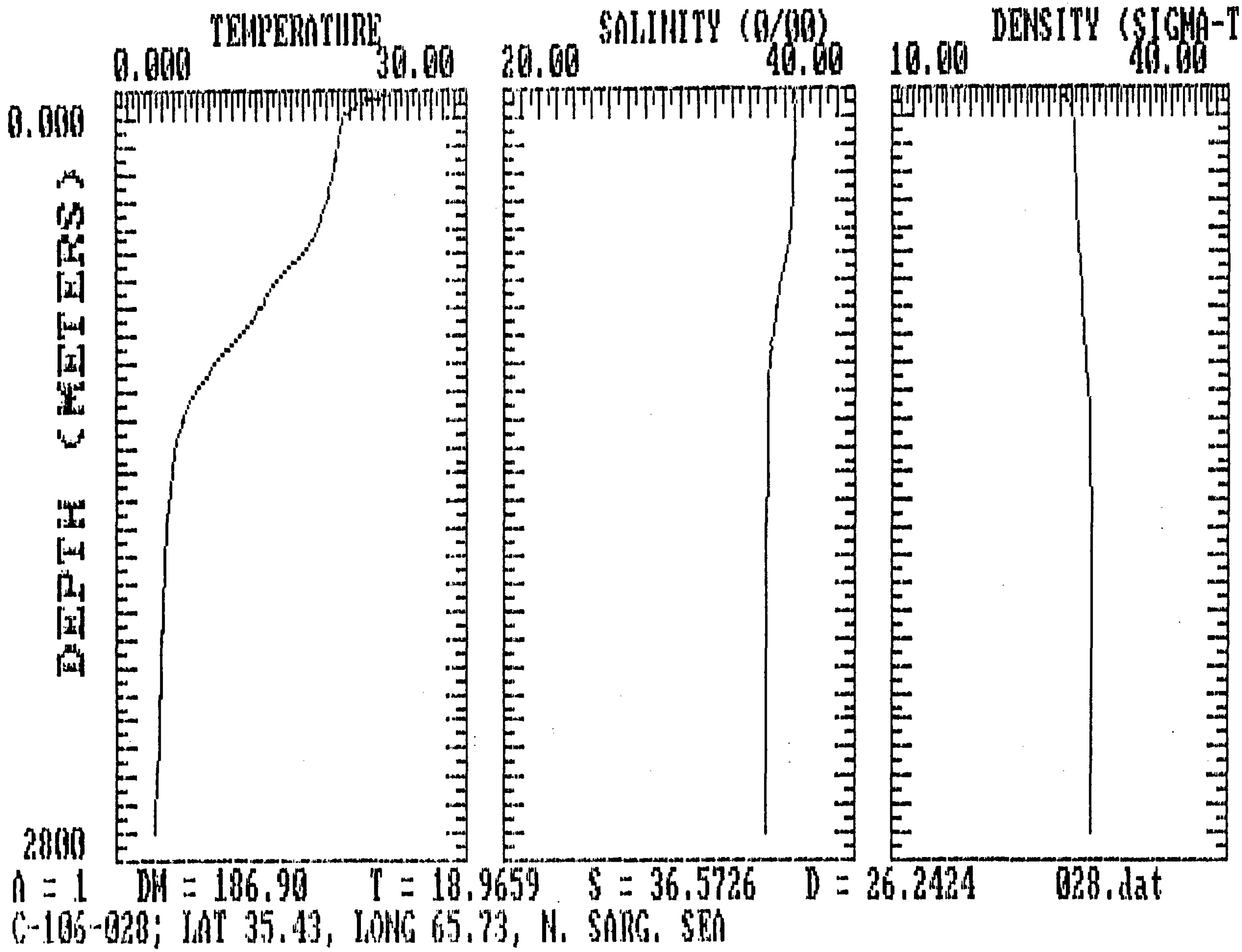
STATION	DATE	TIME	LOG	LAT	LONG	TYPE
C-106-001	25-May-89	0935	104.1	40.28	69.78	Phytoplankton Tow
C-106-002	25-May-89	1116	110.1	40.23	69.70	Neuston Tow A&B
C-106-003	25-May-89	2339	168.3	39.72	68.85	Neuston Tow A&B
C-106-004	26-May-89	1156	190.3	39.35	68.48	Neuston Tow A&B
C-106-005	26-May-89	2330	251.0	38.87	68.88	Neuston Tow A&B
C-106-006	29-May-89	1118	602.5	35.00	66.70	Neuston Tow A&B
C-106-007	29-May-89	2345	641.0	34.67	66.20	Neuston Tow A&B
C-106-008	30-May-89	1201	717.0	33.43	65.72	Neuston Tow A
C-106-009	30-May-89	2327	772.7	32.78	65.17	Neuston Tow A&B
C-106-010	03-Jun-89	1527	826.1	32.42	64.62	Shipek
C-106-011	03-Jun-89	1612	828.1	32.42	64.67	Shipek
C-106-012	03-Jun-89	1657	829.4	32.50	64.67	Shipek
C-106-013	03-Jun-89	1807	830.7	32.53	64.67	Shipek
C-106-014	03-Jun-89	2037	832.4	32.72	64.88	Shipek
C-106-015	03-Jun-89	2050	832.6	32.72	64.88	Shipek
C-106-016	03-Jun-89	2138	832.6	32.50	64.67	Shipek
C-106-017	03-Jun-89	2148	832.6	32.50	64.63	Shipek
C-106-018	03-Jun-89	2312	834.2	32.53	64.62	Neuston Tow A&B
C-106-019	03-Jun-89	2325	834.7	32.55	64.61	Phytoplankton Tow
C-106-020	04-Jun-89	1110	868.9	33.25	64.87	Neuston Tow A&B
C-106-021	04-Jun-89	1645	890.5	33.58	64.88	Hydrocast/CTD
C-106-022	04-Jun-89	1810	890.5	33.58	64.88	Hydrocast
C-106-023	04-Jun-89	2320	896.6	33.75	64.93	Neuston Tow A&B
C-106-024	04-Jun-89	2330	896.8	33.75	64.93	Phytoplankton Tow
C-106-025	05-Jun-89	1115	927.1	34.17	65.19	Neuston Tow A
C-106-026	05-Jun-89	2200	943.0	34.33	65.37	Meter Net
C-106-027	06-Jun-89	1130	990.1	35.08	65.58	Neuston Tow A&B
C-106-028	06-Jun-89	1622	1009.5	35.43	65.73	CTD
C-106-029	06-Jun-89	2330	1030.1	35.83	65.82	Neuston Tow A&B
C-106-030	07-Jun-89	1100	1085.2	36.58	66.18	Neuston Tow A&B
C-106-031	07-Jun-89	1700	1117.1	37.25	66.50	CTD
C-106-032	07-Jun-89	1700	1117.1	37.25	66.50	Hydrocast
C-106-033	08-Jun-89	0205	1165.9	37.99	66.00	CTD
C-106-034	08-Jun-89	0157	1165.9	37.95	66.00	Phytoplankton Tow
C-106-035	08-Jun-89	0600	1165.9	37.97	66.00	Hydrocast
C-106-036	08-Jun-89	0859	1174.4	38.23	66.30	CTD
C-106-037	08-Jun-89	1331	1191.1	38.63	66.46	CTD
C-106-038	08-Jun-89	1715	1205.6	38.85	66.85	CTD
C-106-039	08-Jun-89	1950	1205.6	38.92	27.47	Hydrocast
C-106-040	08-Jun-89	2335	1218.7	39.12	66.40	Neuston Tow A&B
C-106-041	08-Jun-89	2354	1219.1	39.13	66.38	Phytoplankton Tow
C-106-042	09-Jun-89	1115	1250.1	39.40	66.18	CTD
C-106-043	09-Jun-89	2110	1313.6	39.88	67.37	CTD
C-106-044	09-Jun-89	2350	1313.6	39.87	67.35	Shipek
C-106-045	10-Jun-89	0437	1322.6	39.90	67.50	CTD
C-106-046	10-Jun-89	0749	1322.6	39.90	67.50	Rock Dredge
C-106-047	10-Jun-89	1350	1339.9	40.00	67.40	CTD
C-106-048	10-Jun-89	1604	1342.6	40.00	67.37	Shipek
C-106-049	10-Jun-89	2238	1360.3	39.58	67.42	CTD
C-106-050	10-Jun-89	2329	1360.3	39.92	67.42	Shipek
C-106-051	11-Jun-89	0122	1365.1	39.98	67.50	CTD
C-106-052	11-Jun-89	0253	1365.1	39.97	67.42	Shipek
C-106-053	11-Jun-89	0930	1380.5	40.25	67.62	Shipek
C-106-054	11-Jun-89	1045	1380.5	40.27	67.62	Hydrocast
C-106-055	11-Jun-89	1219	1385.4	40.35	67.63	Hydrocast

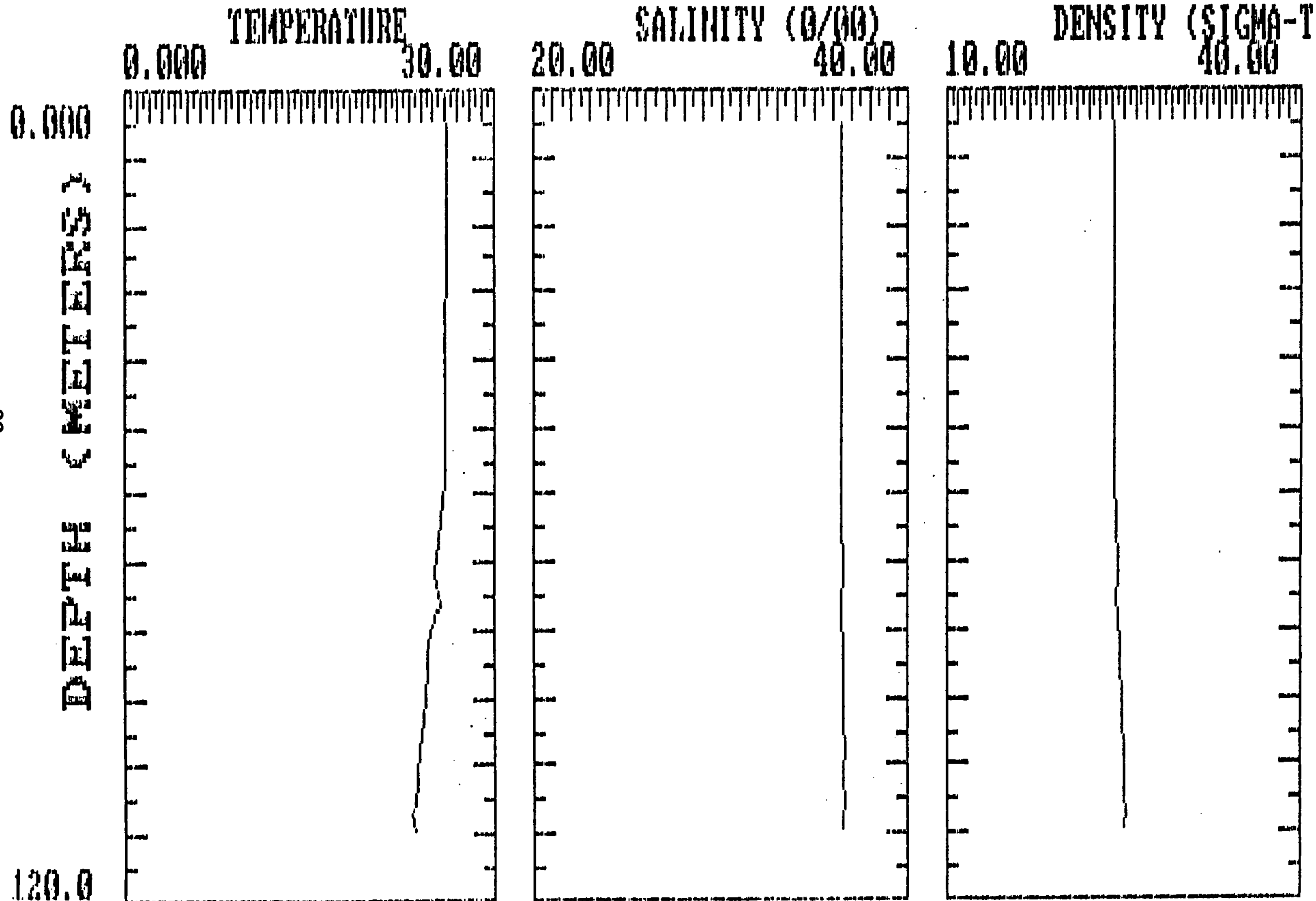
C-106-056	11-Jun-89	1251	1385.4	40.35	67.62	Shipek
C-106-057	11-Jun-89	1821	1401.7	40.40	67.67	Shipek
C-106-058	11-Jun-89	1920	1401.7	40.42	67.67	Hydrocast
C-106-059	11-Jun-89	2125	1408.4	40.50	67.68	Hydrocast
C-106-060	11-Jun-89	2202	1408.4	40.50	67.68	Shipek
C-106-061	11-Jun-89	2346	1411.2	40.57	67.72	Shipek
C-106-062	12-Jun-89	0000	1413.3	40.57	64.72	Hydrocast
C-106-063	12-Jun-89	0150	1417.9	40.50	67.68	Neuston Tow A&B
C-106-064	12-Jun-89	0531	1428.0	40.38	67.57	Meter Nets
C-106-065	12-Jun-89	0811	1438.2	40.52	67.62	Neuston Tow A&B
C-106-066	12-Jun-89	1134	1446.2	40.53	67.60	Meter Nets
C-106-067	12-Jun-89	1758	1476.8	40.93	67.25	Shipek
C-106-068	12-Jun-89	1800	1476.8	40.93	67.25	Hydrocast
C-106-069	12-Jun-89	1830	1477.1	40.95	67.25	Otter Trawl
C-106-070	12-Jun-89	1942	1479.0	40.00	67.23	Otter Trawl
C-106-071	12-Jun-89	2315	1486.8	41.05	67.07	Neuston Tow A&B
C-106-072	13-Jun-89	0035	1490.6	41.08	67.02	Meter Net
C-106-073	13-Jun-89	0602	1515.7	41.33	66.67	Shipek
C-106-074	13-Jun-89	0602	1515.7	41.33	66.67	Hydrocast
C-106-075	13-Jun-89	0633	1515.9	41.33	66.68	Otter Trawl
C-106-076	13-Jun-89	0809	1518.5	41.40	66.68	Otter Trawl
C-106-077	13-Jun-89	0900	1520.0	41.42	66.68	Otter Trawl
C-106-078	14-Jun-89	0420	1584.6	41.40	66.35	Shipek
C-106-079	14-Jun-89	0455	1584.6	41.40	66.35	Hydrocast
C-106-080	14-Jun-89	0525	1584.6	41.38	66.35	Meter Nets
C-106-081	14-Jun-89	0945	1602.6	41.32	66.12	Shipek
C-106-082	14-Jun-89	1025	1602.6	41.30	66.12	Hydrocast
C-106-083	14-Jun-89	1025	1602.6	41.30	66.12	CTD
C-106-084	14-Jun-89	1340	1614.3	41.37	66.15	Shipek
C-106-085	14-Jun-89	1431	1614.4	41.40	66.22	Hydrocast
C-106-086	14-Jun-89	1718	1623.2	41.40	66.20	Hydrocast
C-106-087	14-Jun-89	1743	1624.2	41.39	66.29	Shipek
C-106-088	14-Jun-89	2020	1633.6	41.32	66.03	Meter Net
C-106-089	14-Jun-89	2207	1635.7	41.32	65.97	Meter Net
C-106-090	15-Jun-89	0215	1640.2	41.33	65.93	Phytoplankton Tow
C-106-091	15-Jun-89	1100	1698.9	42.22	65.70	Neuston Tow A&B
C-106-092	15-Jun-89	1610	1711.9	42.48	65.72	Hydrocast
C-106-093	15-Jun-89	1610	1711.9	42.48	65.72	Shipek
C-106-094	15-Jun-89	1630	1711.9	42.48	65.77	Otter Trawl
C-106-095	15-Jun-89	1725	1713.1	42.50	65.80	Otter Trawl
C-106-096	15-Jun-89	2315	1736.6	42.78	65.75	Neuston Tow A&B
C-106-097	16-Jun-89	2315	1866.9	43.43	65.18	Neuston Tow A&B
C-106-098	19-Jun-89	1941	1884.0	43.69	65.33	Fisher Scoop
C-106-099	19-Jun-89	1945	1884.6	43.68	65.32	Fisher Scoop
C-106-100	19-Jun-89	1950	1884.7	43.68	65.32	Fisher Scoop
C-106-101	19-Jun-89	1957	1885.2	43.68	65.31	Fisher Scoop
C-106-102	19-Jun-89	2005	1886.0	43.66	65.29	Fisher Scoop
C-106-103	19-Jun-89	2052	1887.8	43.64	65.25	Fisher Scoop A&B
C-106-104	19-Jun-89	2326	1898.4	43.48	65.21	Neuston A
C-106-105	20-Jun-89	2125	1966.8	42.75	45.45	Shipek
C-106-106	20-Jun-89	2125	1966.8	42.77	66.05	Hydrocast
C-106-107	20-Jun-89	2155	1966.8	42.78	66.06	Otter Trawl
C-106-108	21-Jun-89	0359	2000.3	42.25	66.33	Meter Net
C-106-109	21-Jun-89	0830	2027.9	42.07	66.56	Meter Net
C-106-110	21-Jun-89	1213	2039.2	42.06	66.55	Shipek&Niskin Bottle
C-106-111	21-Jun-89	1251	2039.9	42.07	66.55	Otter Trawl

C-106-112	21-Jun-89	2048	2068.9	42.16	66.99	Shipek
C-106-113	21-Jun-89	2113	2068.9	42.17	67.00	Otter Trawl
C-106-114	21-Jun-89	2333	2075.4	42.24	67.10	Neuston A&B
C-106-115	22-Jun-89	1655	2147.1	42.88	67.73	Shipek & Hydrocast
C-106-116	22-Jun-89	2032	2160.0	41.98	67.75	Shipek
C-106-117	22-Jun-89	2050	2161.1	42.00	67.75	Otter Trawl
C-106-118	22-Jun-89	2102	2161.4	42.20	67.91	Rock Dredge
C-106-119	23-Jun-89	0126	2172.1	42.21	67.92	Meter Net
C-106-120	23-Jun-89	1325	2256.7	42.29	69.32	Meter Net
C-106-121	23-Jun-89	2007	2293.4	42.21	70.17	Shipek&Niskin Bottle
C-106-122	23-Jun-89	2020	2294.7	42.21	70.18	Otter Trawl
C-106-123	24-Jun-89	0340	2309.3	42.25	70.33	Hydrocast
C-106-124	27-Jun-89	0750	2457.7	42.26	70.23	Hydrocast
C-106-125	27-Jun-89	1430	2470.4	42.19	70.20	Meter Net
C-106-126	29-Jun-89	1615	2668.4	40.39	68.28	Shipek
C-106-127	29-Jun-89	1632	2668.4	40.39	68.28	Gravity Core A&B
C-106-128	30-Jun-89	1200	2738.5	39.81	69.48	Open-Close Net
C-106-129	30-Jun-89	1628	2743.3	39.85	69.63	Stereo Neuston Tow

APPENDIX 3. Conductivity-temperature-depth sensor (CTD) data.

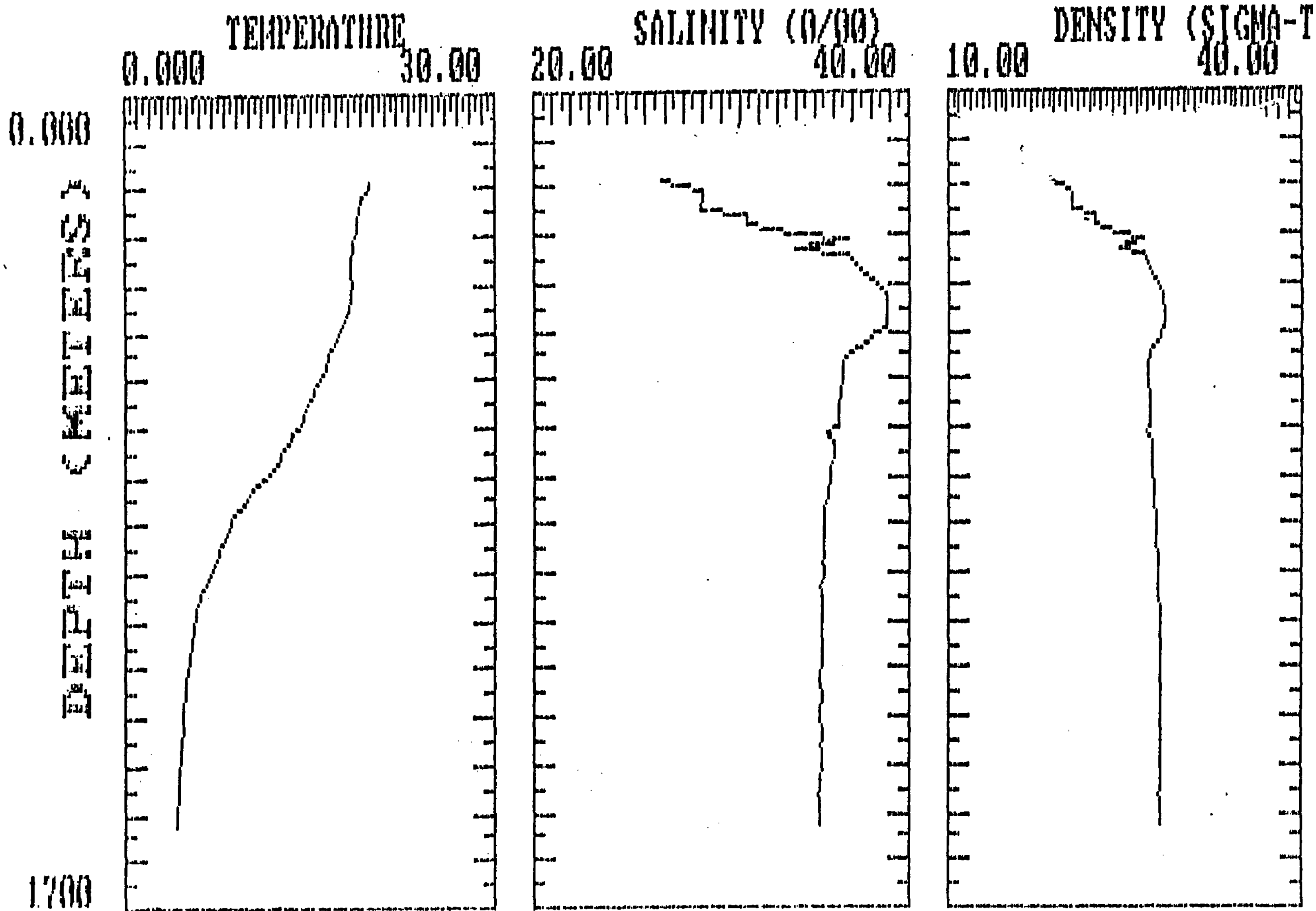



TEMPERATURE
0.000
30.00
SALINITY (0/00)
20.00
40.00
DENSITY (SIGMA-T
10.00
40.00
0.000
DEPTH (METERS)
2800
A = 1 DM = 186.90 T = 18.9659 S = 36.5726 D = 26.2424 028.dat
C-106-028; LAT 35.43, LONG 65.73, N. SARG. SEA

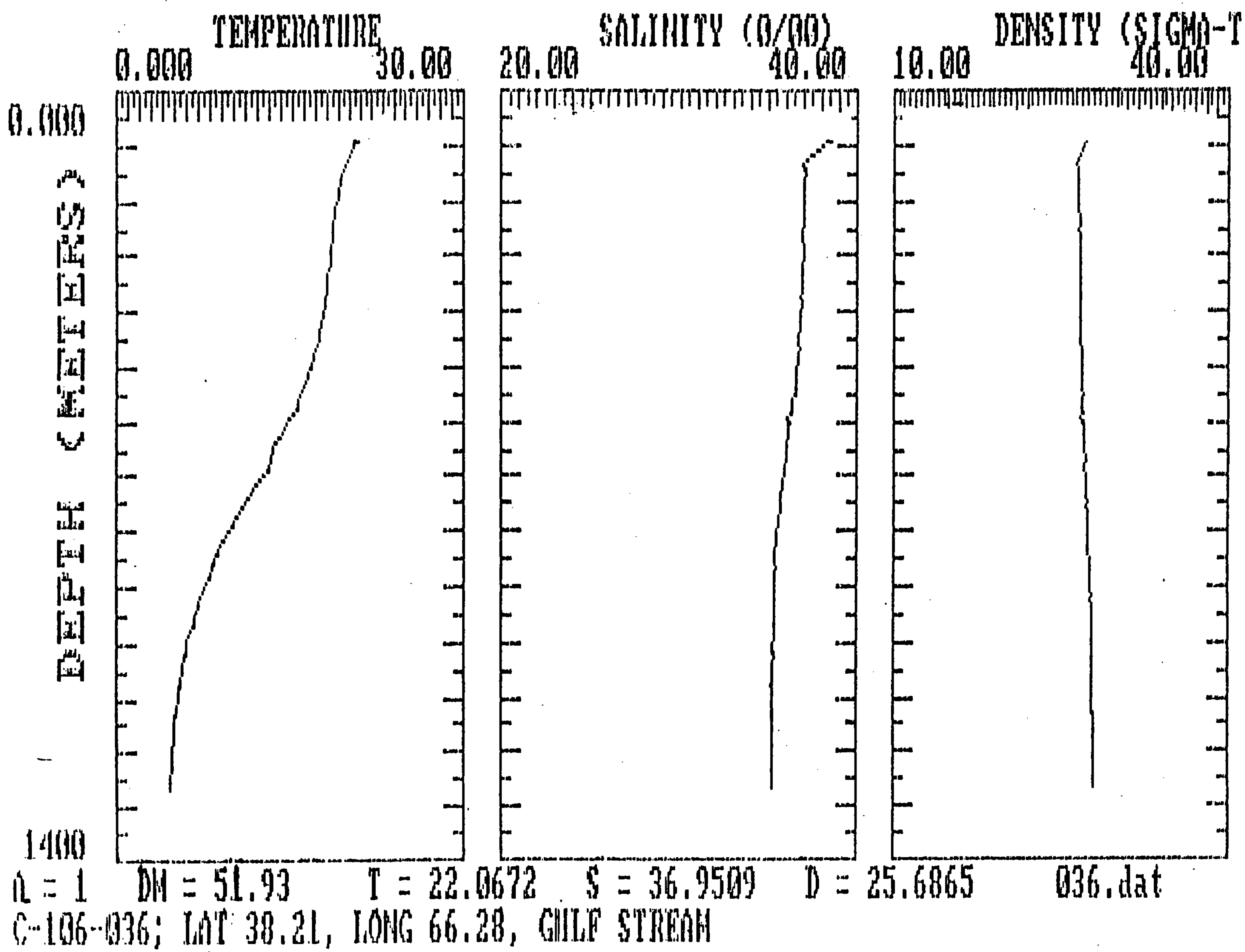


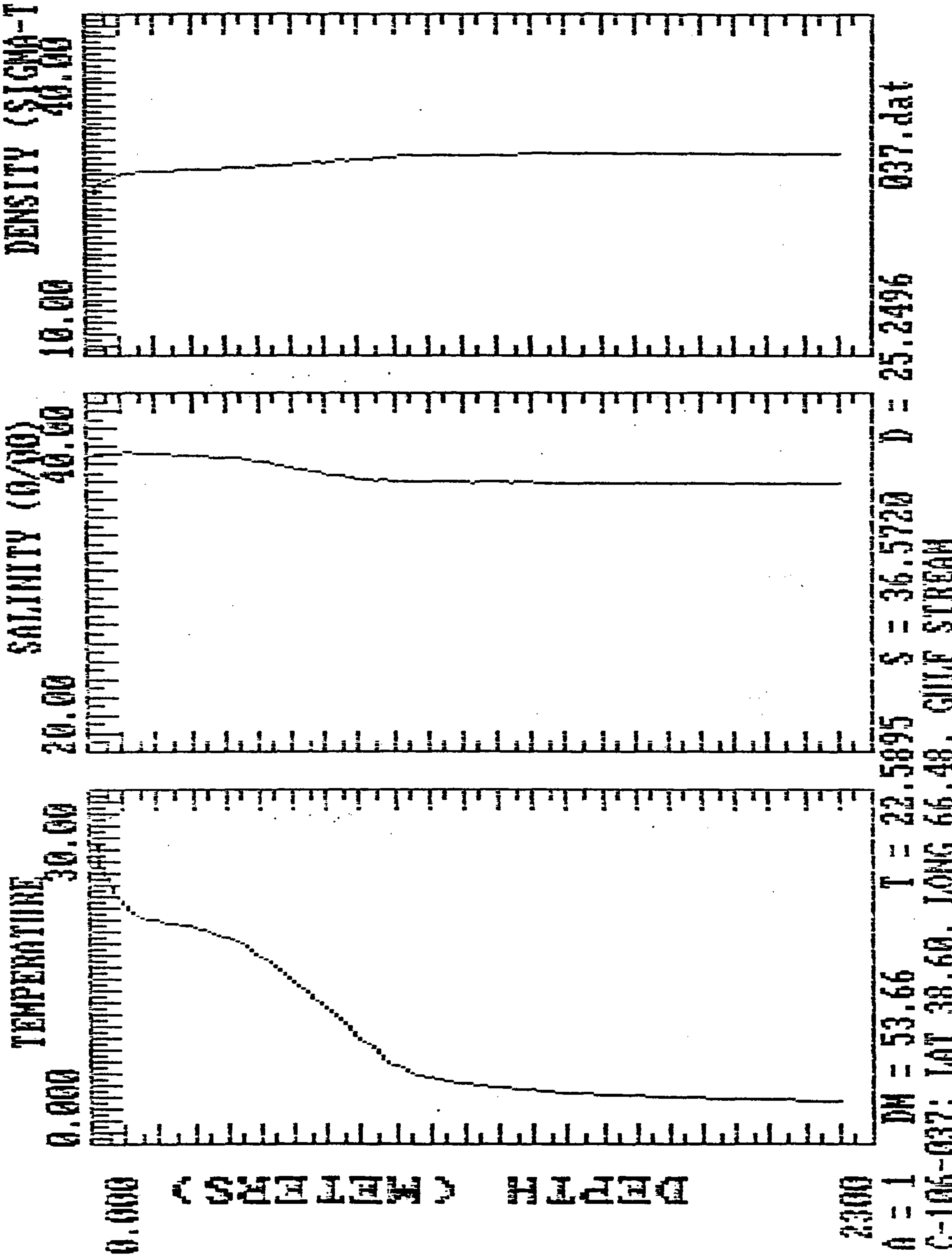
N = 1 DM = 12.12 T = 26.0873 S = 36.4717 D = 24.1196 031.dat

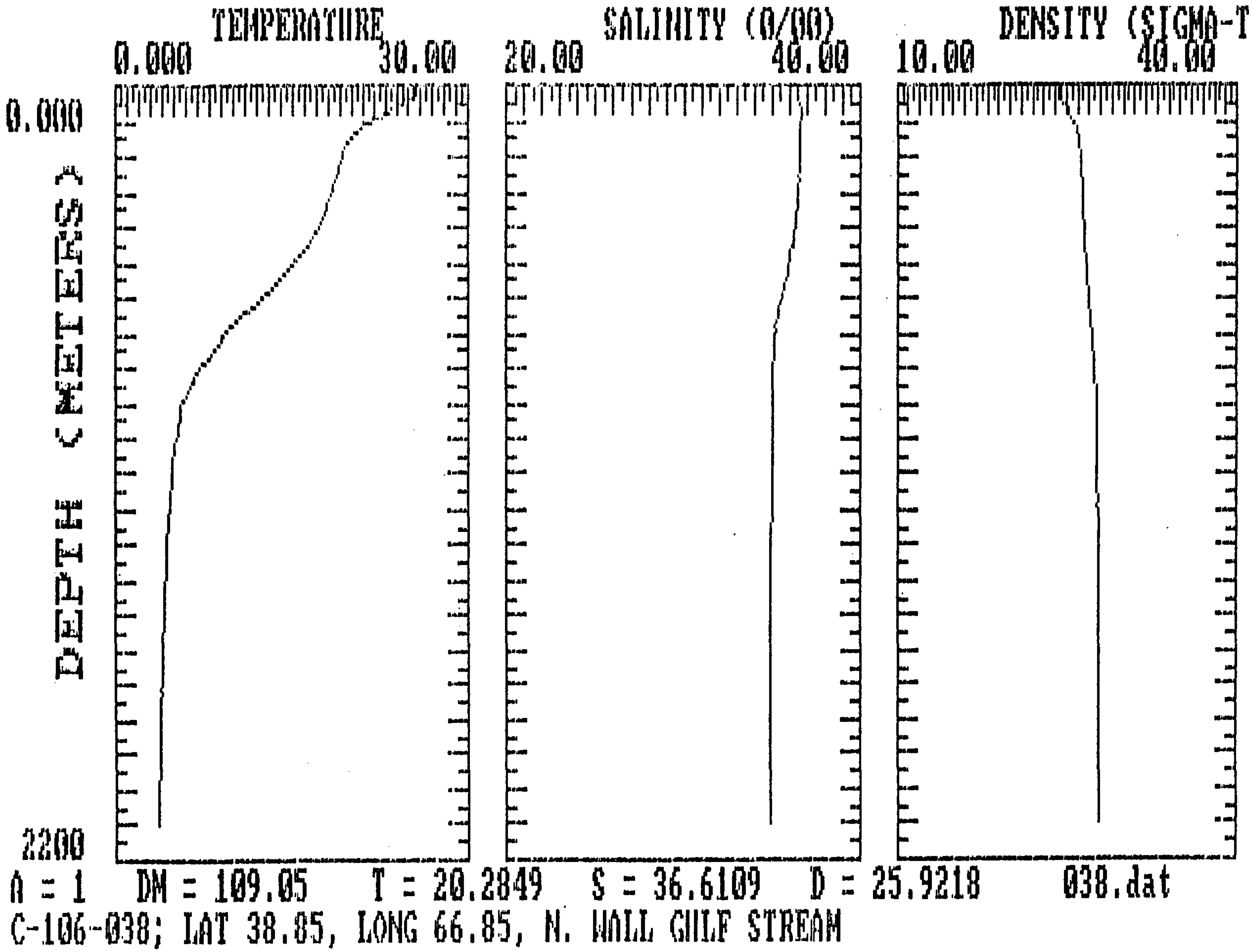
C-106-031; LAT 37.25, LONG 66.46, GULF STREAM

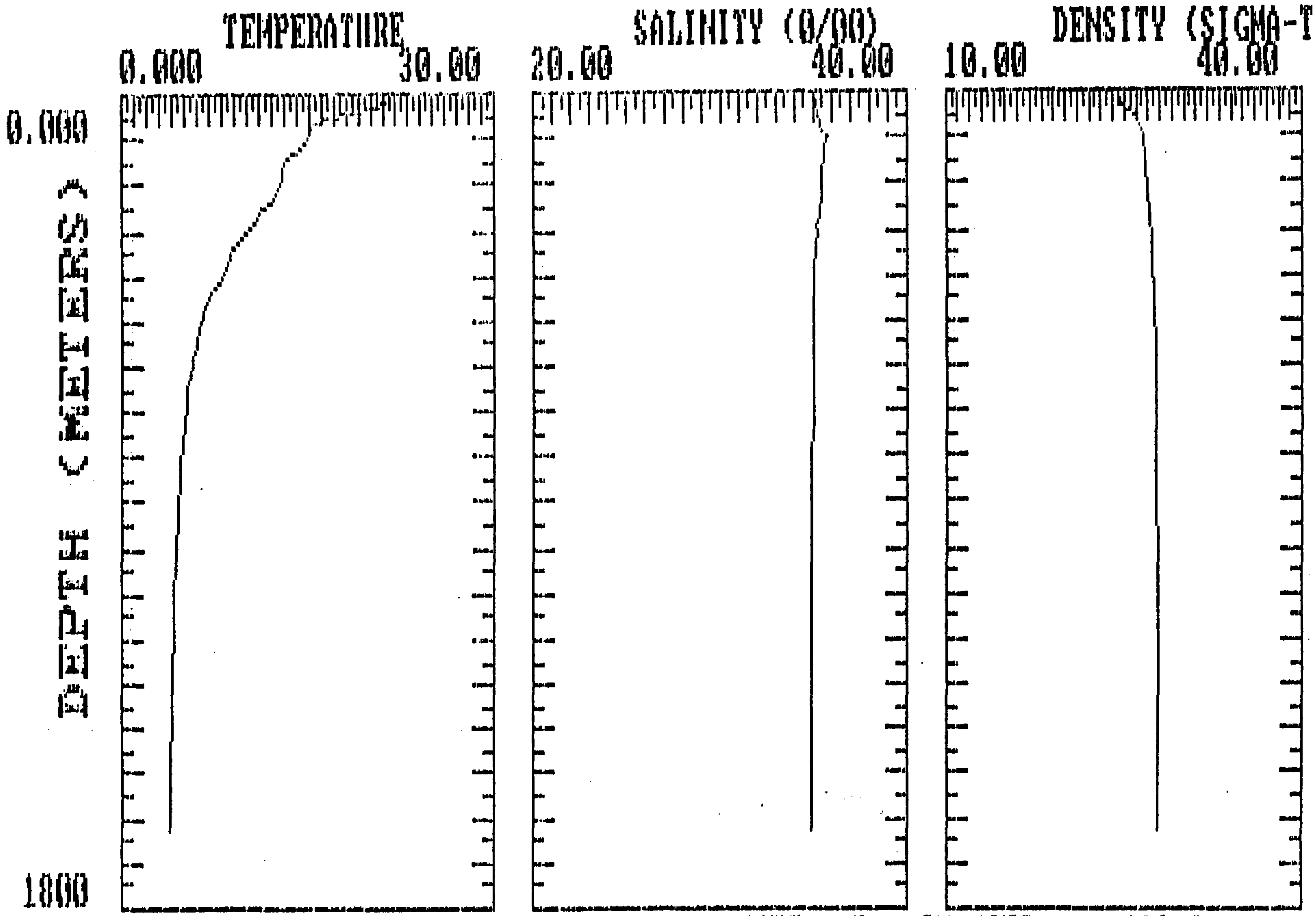


n = 1 DM = 326.96 T = 18.3265 S = 37.3047 D = 26.9722 033.dat
C-106-033; LAT 37.96, LONG 66.00, GULF STREAM

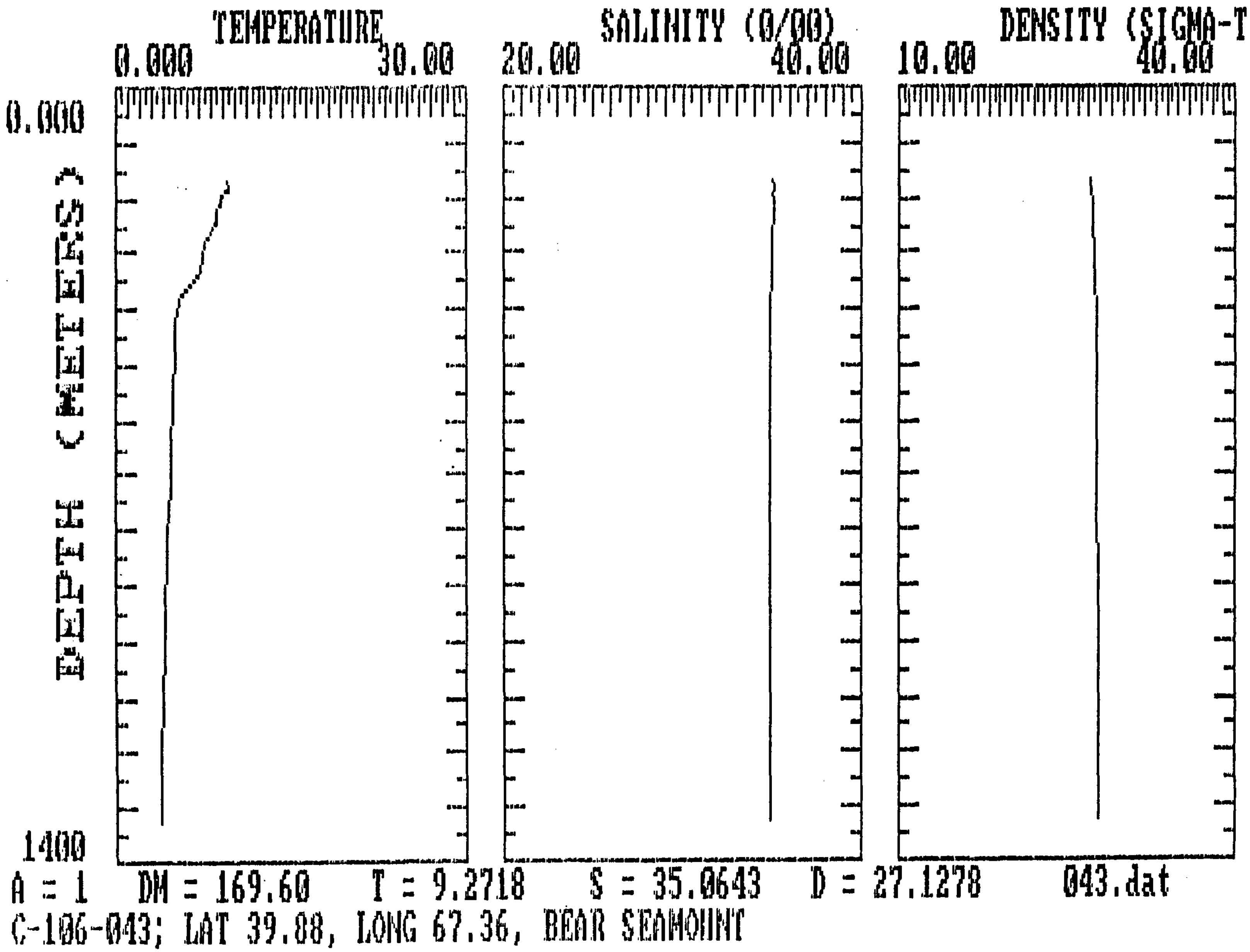

TEMPERATURE
0.000
30.00
SALINITY (0/00)
20.00
40.00
DENSITY (SIGMA-T
10.00
40.00
0.000
DEPTH (METERS)
1400
n = 1 DM = 51.93 T = 22.0672 S = 36.9509 D = 25.6865 036.dat
C-106-036; LAT 38.21, LONG 66.28, GULF STREAM

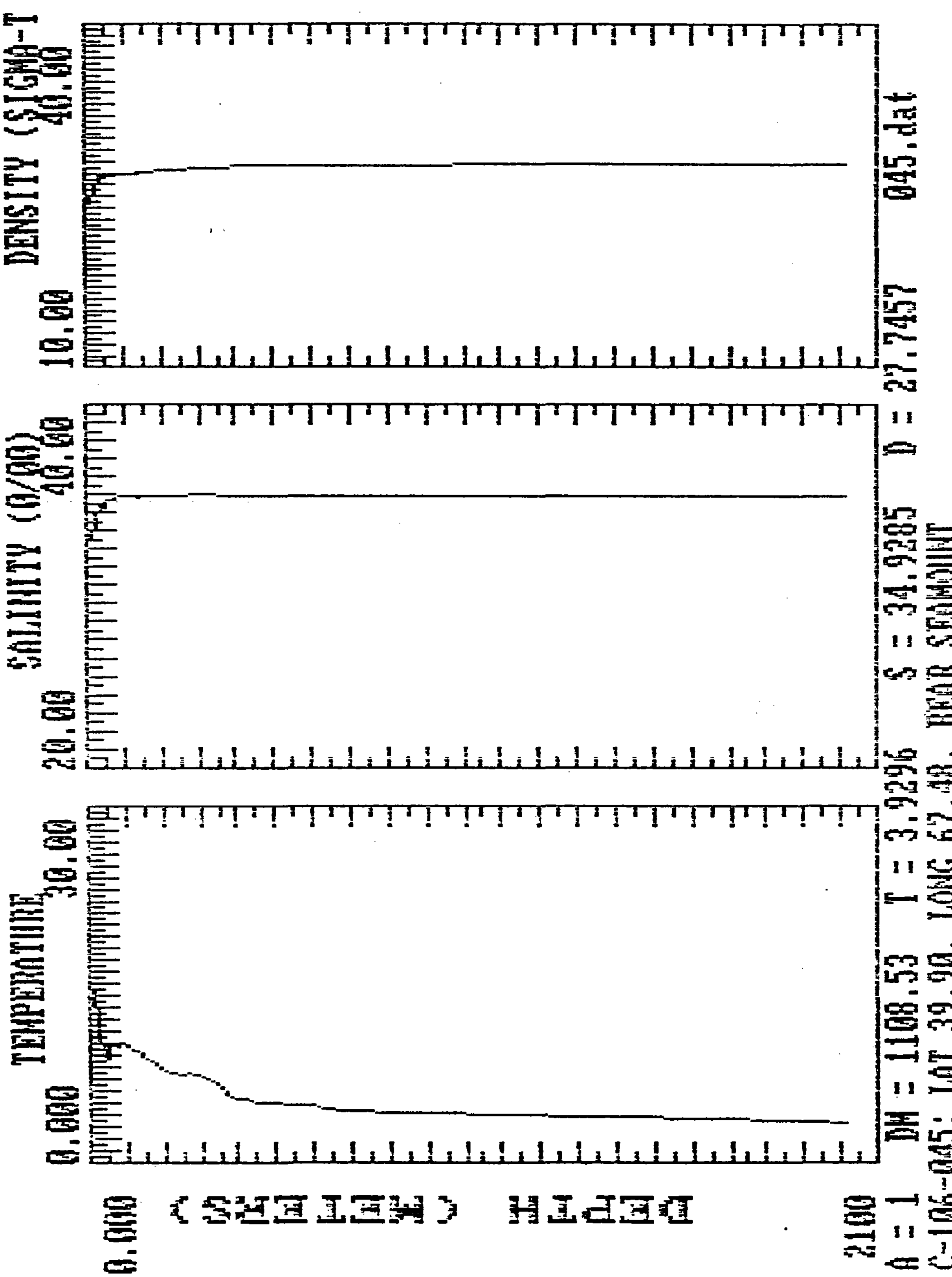

TEMPERATURE
0.000
30.00
SALINITY (0/00)
20.00
40.00
DENSITY (SIGMA-T)
10.00
40.00
DEPTH (METERS)
0.000
2300
A = 1 DM = 53.66 T = 22.5895 S = 36.5720 D = 25.2496
C-106-037; LAT 38.60, LONG 66.48, GULF STREAM
037.dat

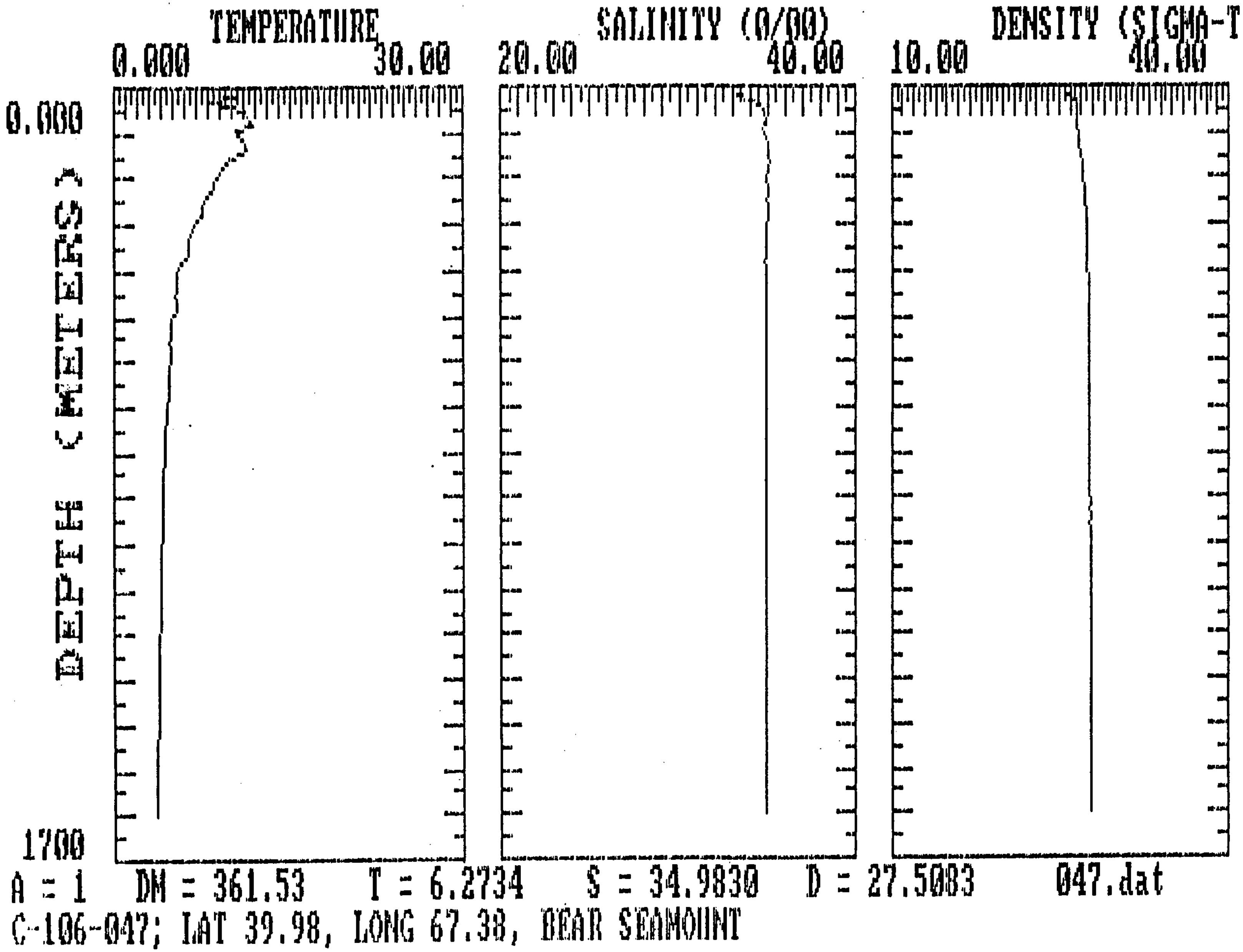

TEMPERATURE
0.000
30.00
SALINITY (O/OO)
20.00
40.00
DENSITY (SIGMA-T
10.00
40.00
0.000
DEPTH (METERS)
2200
A = 1 DM = 109.05 T = 20.2849 S = 36.6109 D = 25.9218 038.dat
C-106-038; LAT 38.85, LONG 66.85, N. WALL GULF STREAM



A = 1   DM = 415.10   T = 7.3663   S = 35.0670   D = 27.4259   042.dat
C-106-042; LAT 39.40, LONG 66.18, N. WALL GULF STREAM


TEMPERATURE
0.000
30.00
SALINITY (0/00)
20.00
40.00
DENSITY (SIGMA-T
10.00
40.00
0.000
DEPTH (METERS)
1400
A = 1 DM = 169.60 T = 9.2718 S = 35.0643 D = 27.1278 043.dat
C-106-043; LAT 39.88, LONG 67.36, BEAR SEAMOUNT


TEMPERATURE
0.000
30.00
SALINITY (0/00)
20.00
40.00
DENSITY (SIGMA-T)
10.00
40.00
DEPTH (METERS)
0.000
2100
A = 1 DH = 1108.53 T = 3.9296 S = 34.9285 D = 27.7457 045.dat
C-106-045; LAT 39.90, LONG 67.48, BEAR SEAMOUNT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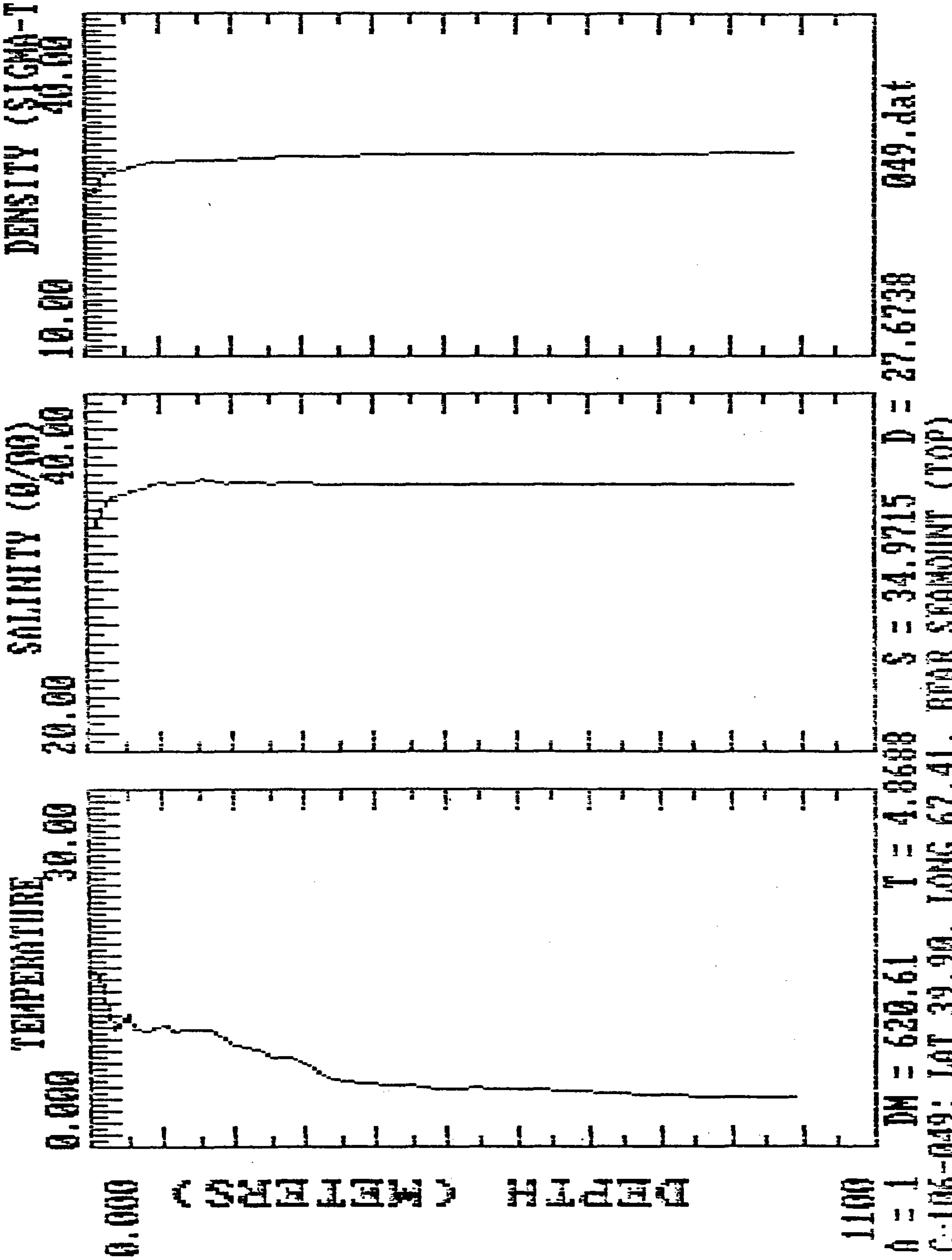
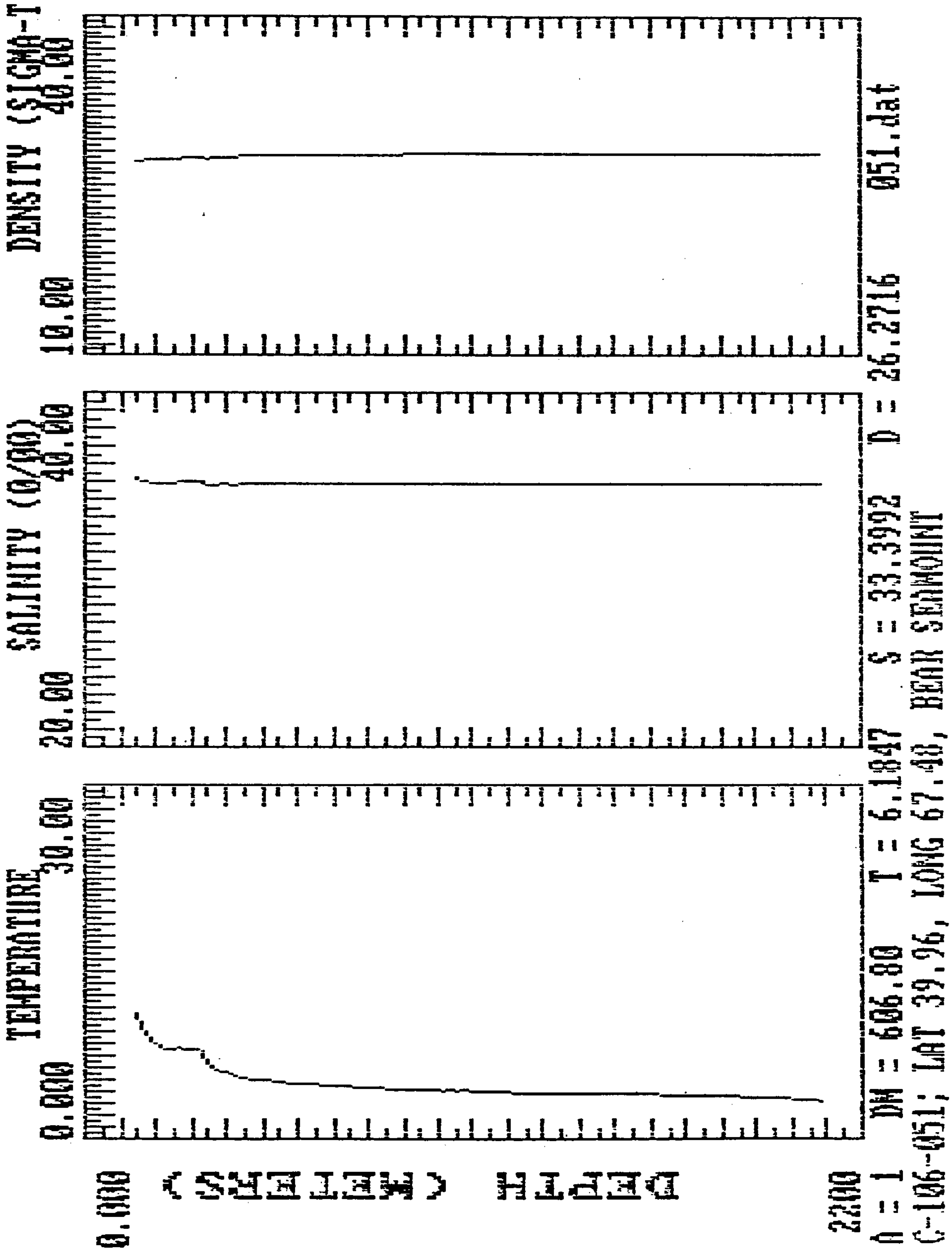
SALINITY (0/00)
20.00
40.00
DENSITY (SIGMA-T
10.00
40.00
0.000
DEPTH (METERS)
1700
A = 1 DM = 361.53 T = 6.2734 S = 34.9830 D = 27.5083 047.dat
C-106-047; LAT 39.98, LONG 67.38, BEAR SEAMOUNT


TEMPERATURE
0.000
30.00
SALINITY (0/00)
20.00
40.00
DENSITY (SIGMA-T)
10.00
40.00
DEPTH (METERS)
0.000
1100
N = 1 DM = 620.61 T = 4.8688 S = 34.9715 D = 27.6738
C-106-049; LAT 39.90, LONG 67.41, BEAR SEAMOUNT (TOP)
049.dat


TEMPERATURE
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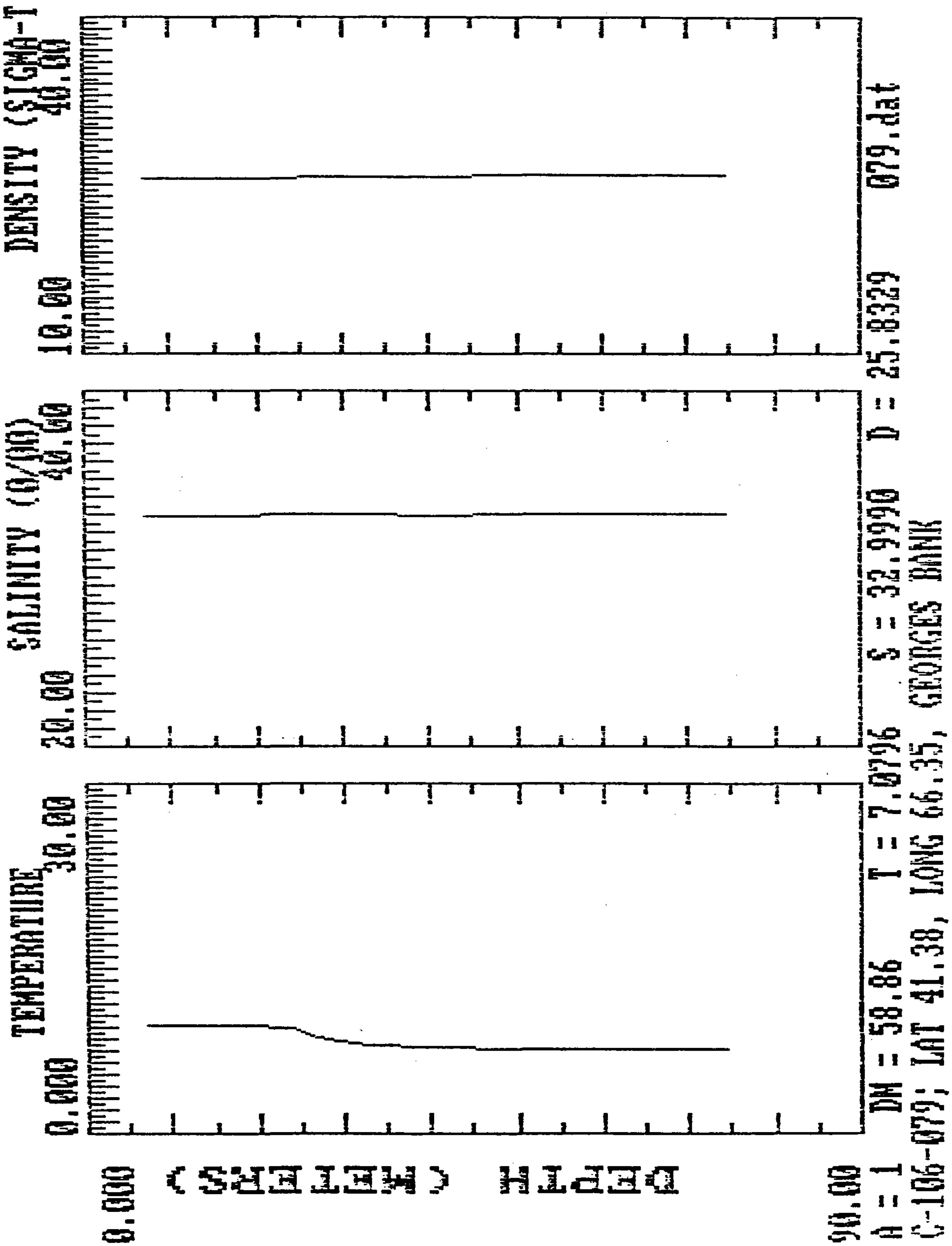
30.00
SALINITY (O/OO)
20.00
40.00
DENSITY (SIGMA-T)
10.00
40.00
DEPTH (METERS)
0.000
2200
N = 1 DM = 606.80 T = 6.1847 S = 33.3992 D = 26.2716
C-106-051; LAT 39.96, LONG 67.40, BEAR SEAMOUNT 051.dat


TEMPERATURE
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SALINITY (0/00)
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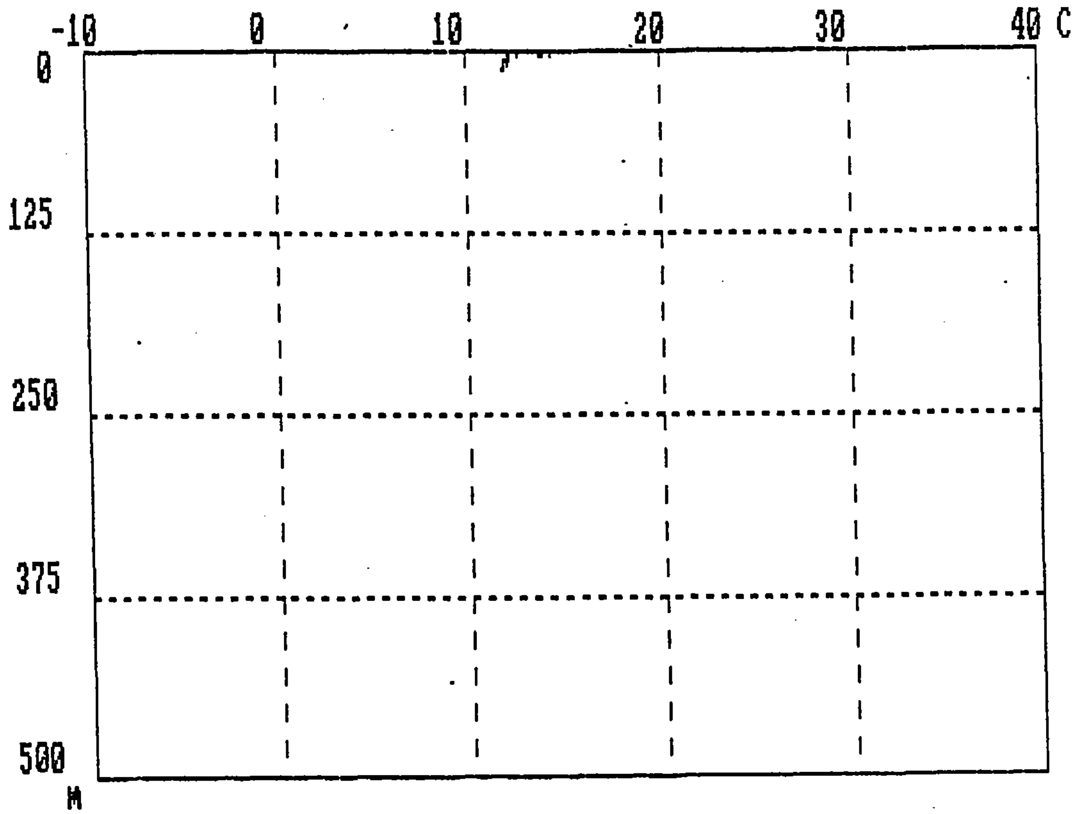
40.00
DENSITY (SIGMA-T
10.00
40.00
DEPTH (METERS)
0.000
90.00
A = 1 DM = 58.86 T = 7.0796 S = 32.9990 D = 25.8329 079.dat
C-106-079; LAT 41.38, LONG 66.35, GEORGES BANK

APPENDIX 4. Bathythermograph station listing.

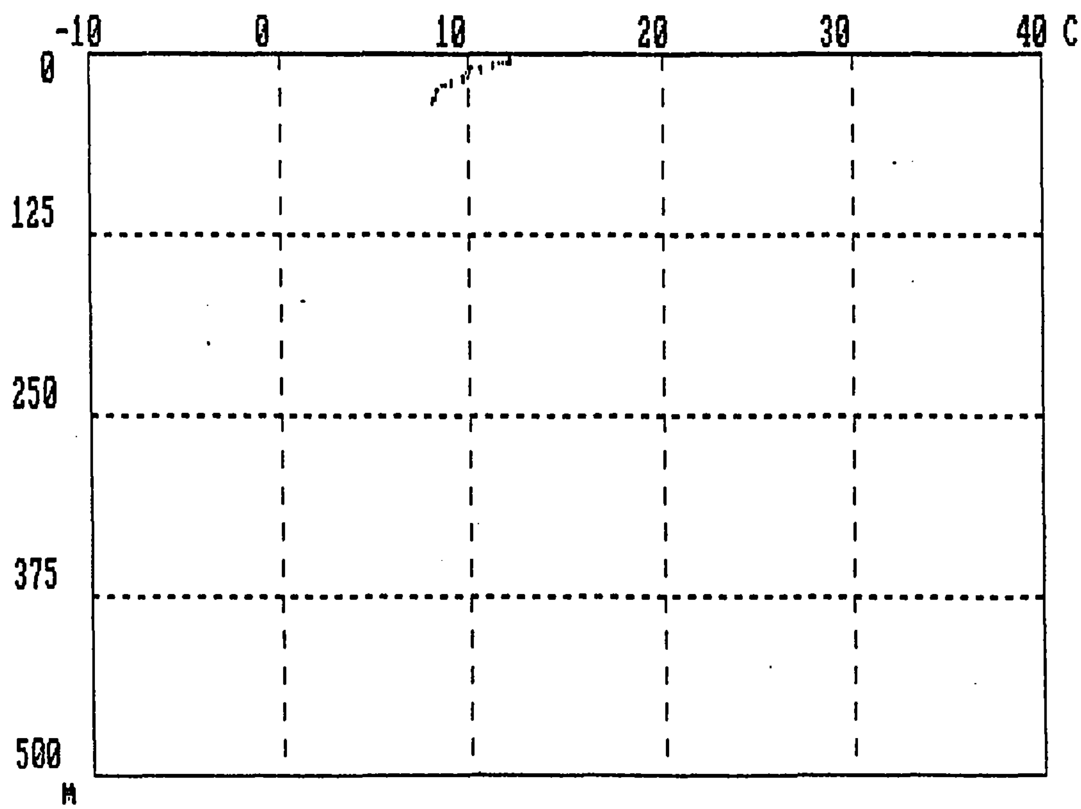
STATION	DATE	TIME	LOG	LAT	LONG	SURFTEM
BT-001	24-May-89	1510	21.0	41.28	70.96	13.4
BT-002	24-May-89	1815	41.0	41.03	70.76	12.6
BT-003	24-May-89	2134	60.0	40.75	70.55	12.0
BT-004	25-May-89	0300	80.0	40.52	70.25	12.2
BT-005	25-May-89	0731	100.5	40.32	69.85	11.3
BT-006	25-May-89	1350	120.0	40.32	69.52	12.0
BT-007	25-May-89	1648	135.0	40.06	69.43	12.4
BT-008	25-May-89	1730	138.5	40.02	69.37	12.6
BT-009	25-May-89	1823	142.3	39.98	69.30	12.8
BT-010	25-May-89	1918	146.3	40.00	69.27	12.9
BT-011	25-May-89	2002	150.3	39.92	69.18	13.3
BT-012	25-May-89	2045	154.3	39.87	69.12	13.3
BT-013	25-May-89	2130	158.3	39.83	69.07	13.7
BT-014	25-May-89	2203	162.3	39.68	68.97	13.8
BT-015	26-May-89	0836	181.5	39.42	68.52	13.5
BT-016	26-May-89	1411	201.0	39.25	68.65	14.9
BT-017	26-May-89	1745	221.2	39.02	68.97	14.1
BT-018	26-May-89	2130	240.5	38.86	69.03	19.0
BT-019	27-May-89	0125	261.5	38.83	68.62	18.9
BT-020	27-May-89	0320	276.9	38.75	68.30	21.2
BT-021	27-May-89	0645	297.4	38.62	67.00	16.4
BT-022	27-May-89	1030	317.4	38.68	68.23	20.6
BT-023	27-May-89	1525	337.4	38.45	67.95	18.4
BT-024	27-May-89	2320	373.6	38.25	67.22	24.0
BT-025	28-May-89	0248	396.6	38.02	67.25	23.4
BT-026	28-May-89	0330	402.2	37.97	67.30	23.0
BT-027	28-May-89	0721	431.1	37.57	67.55	18.9
BT-028	28-May-89	0826	437.1	37.48	67.60	19.4
BT-029	28-May-89	0915	441.4	37.43	67.67	19.4
BT-030	28-May-89	1001	445.0	37.38	67.70	19.1
BT-031	28-May-89	1052	448.9	37.32	67.72	19.3
BT-032	28-May-89	1135	453.0	37.25	67.72	19.3
BT-033	28-May-89	1222	458.0	37.17	67.70	20.3
BT-034	28-May-89	1305	462.3	37.12	67.67	19.3
BT-035	28-May-89	1350	467.7	37.03	67.60	18.9
BT-036	28-May-89	1529	479.6	36.85	67.47	20.4
BT-037	28-May-85	1725	494.8	36.65	67.33	25.6
BT-038	28-May-89	1945	514.8	36.38	67.27	22.3
BT-039	28-May-89	2245	535.8	36.05	67.28	22.7
BT-040	29-May-89	0217	556.1	35.72	67.25	22.7
BT-041	29-May-89	0540	575.7	35.43	66.98	22.1
BT-042	29-May-89	0950	596.6	35.18	66.78	21.9
BT-043	29-May-89	1625	619.6	34.95	66.50	22.6
BT-044	29-May-89	2235	638.7	34.72	66.23	22.3
BT-045	30-May-89	0320	661.9	34.33	66.02	22.7
BT-046	30-May-89	0740	694.9	33.80	65.75	22.5
BT-047	30-May-89	1130	716.9	33.45	65.70	23.0
BT-048	30-May-89	1840	737.4	33.07	65.60	23.6
BT-049	30-May-89	2120	757.1	32.90	65.37	22.6
BT-050	31-May-89	0045	778.1	32.73	65.05	23.2
BT-051	31-May-89	0325	796.5	32.62	64.73	22.5
BT-052	11-Jun-89	0740	1375.1	40.15	67.57	13.9
BT-053	11-Jun-89	0806	1376.9	40.20	67.60	14.0
BT-054	11-Jun-89	0845	1378.8	40.22	67.60	14.1
BT-055	11-Jun-89	1117	1380.9	40.28	67.60	13.1

BT-056	11-Jun-89	1145	1383.5	40.32	67.62	12.8
BT-057	11-Jun-89	1324	1385.9	40.37	67.63	12.5
BT-058	11-Jun-89	1439	1389.5	40.43	67.06	12.6
BT-059	11-Jun-89	2010	1405.0	40.45	67.67	12.5
BT-060	11-Jun-89	2100	1407.8	40.48	67.68	12.4
BT-061	11-Jun-89	2300	1410.7	40.53	67.72	12.4
BT-062	14-Jun-89	0715	1591.9	No	Data	
BT-063	14-Jun-89	0735	1591.9	41.33	66.23	10.4
BT-064	14-Jun-89	0821	1593.9	41.33	66.18	12.6
BT-065	14-Jun-89	0950	1596.7	41.33	66.13	12.6
BT-066	14-Jun-89	1125	1603.2	41.30	66.07	13.4
BT-067	14-Jun-89	1200	1605.3	41.30	66.03	11.9
BT-068	14-Jun-89	1230	1608.0	41.32	66.05	12.3
BT-069	14-Jun-89	1251	1610.5	41.33	66.08	13.7
BT-070	14-Jun-89	1315	1613.2	41.35	66.13	14.0
BT-071	14-Jun-89	1510	1616.2	41.33	66.17	14.0
BT-072	14-Jun-89	1615	1621.7	41.42	66.25	12.4
BT-073	14-Jun-89	1810	1624.7	41.38	66.18	13.0

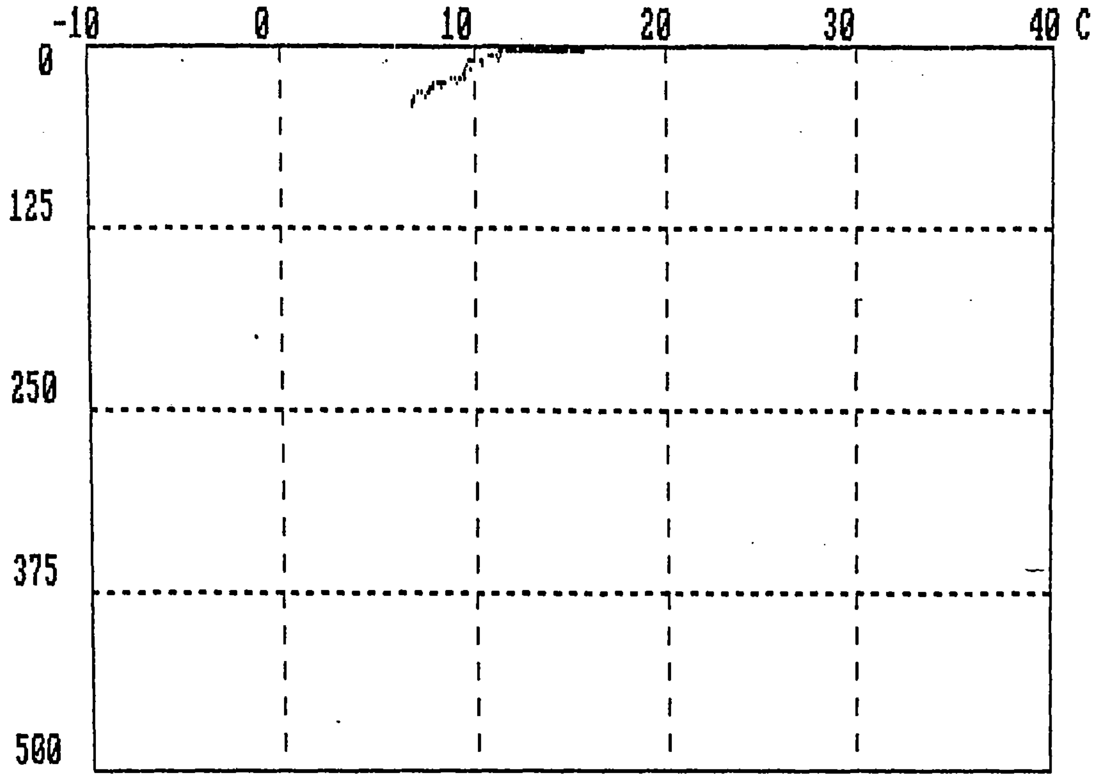
APPENDIX 5. Bathythermograph data.



BT-001



BT-002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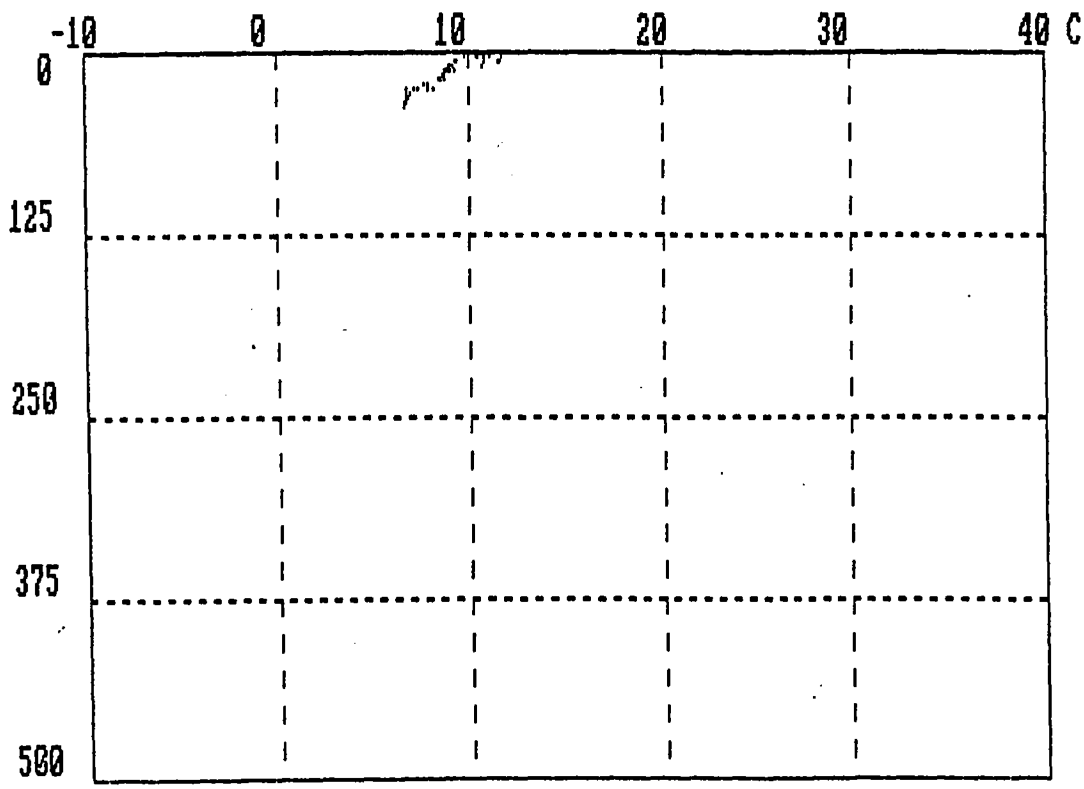
10
20
30
40 C
0
125
250
375
500
M
BT-003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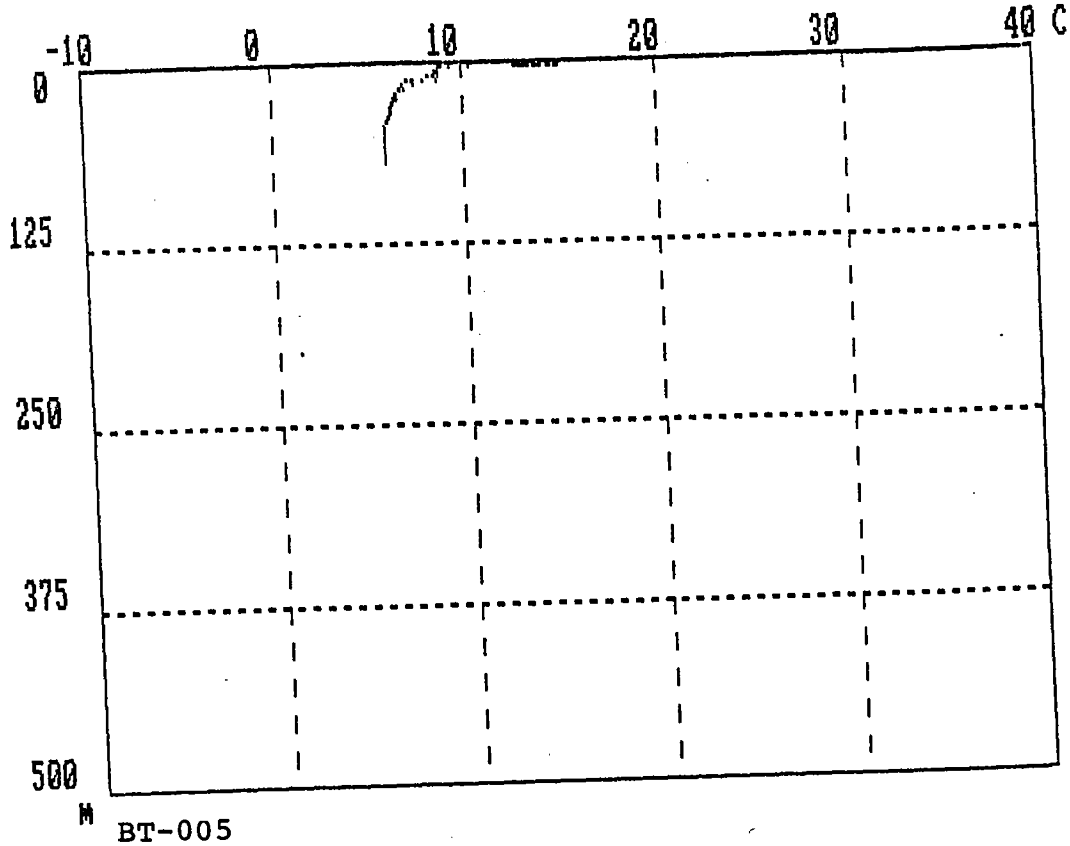
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125
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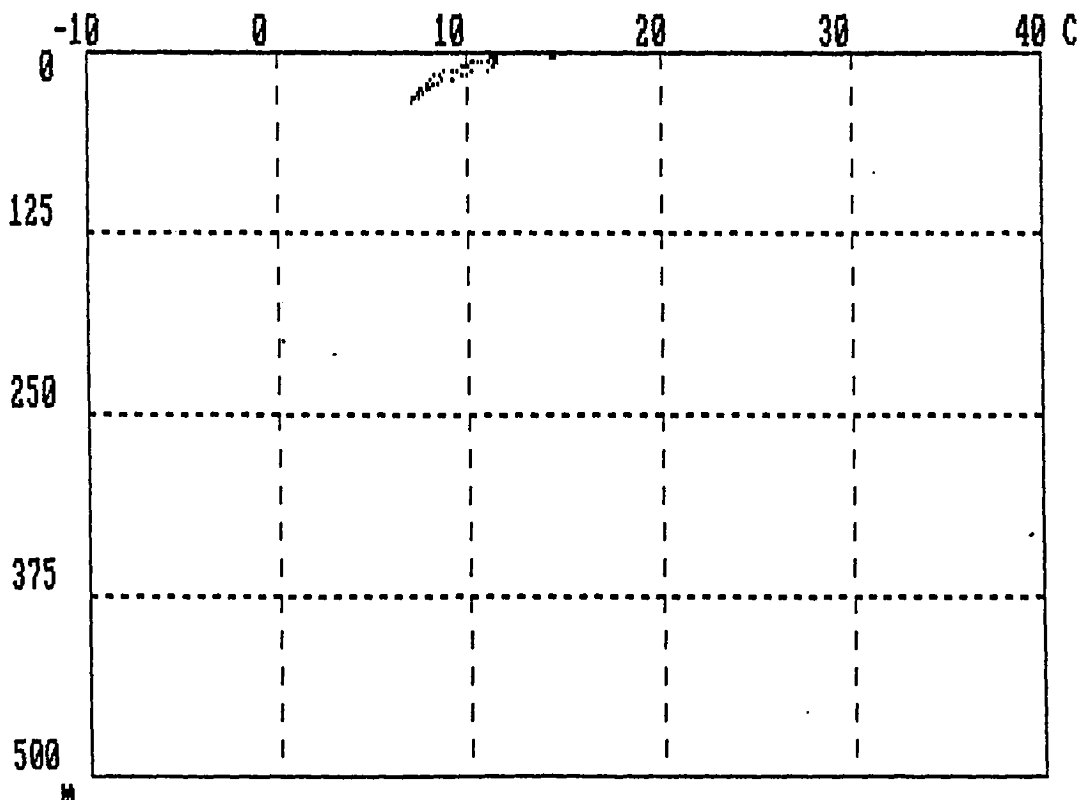
500
M

BT-005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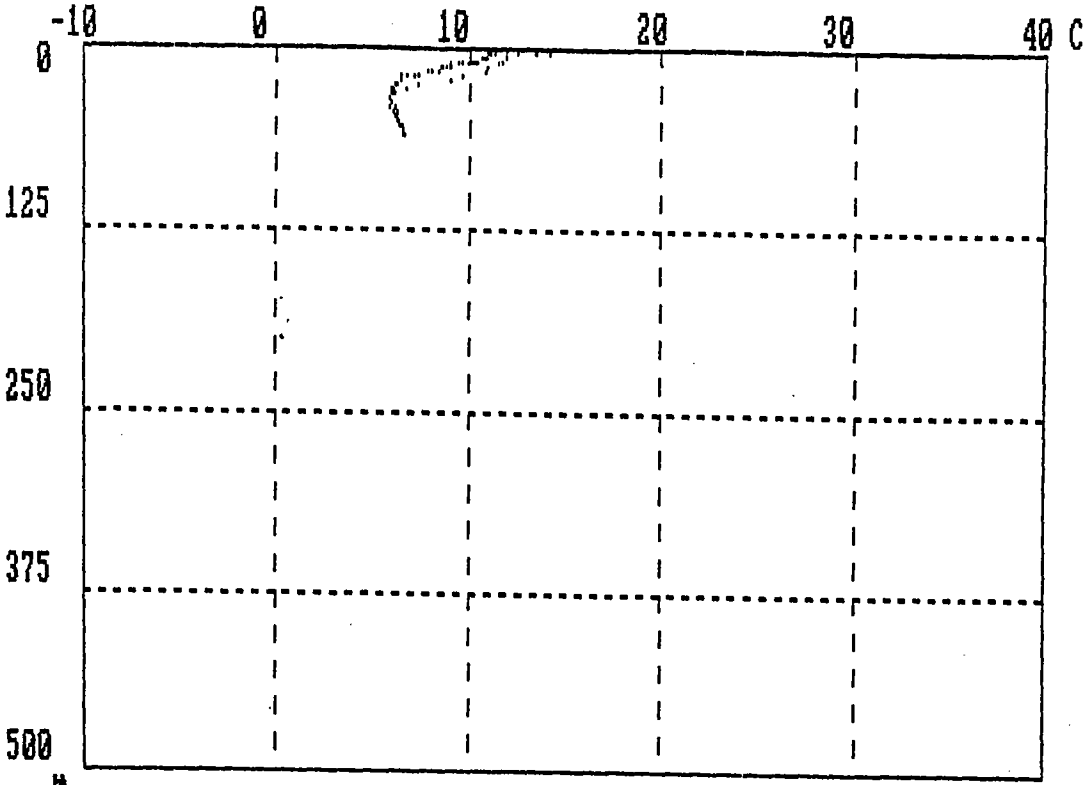
250
375
500
M

BT-006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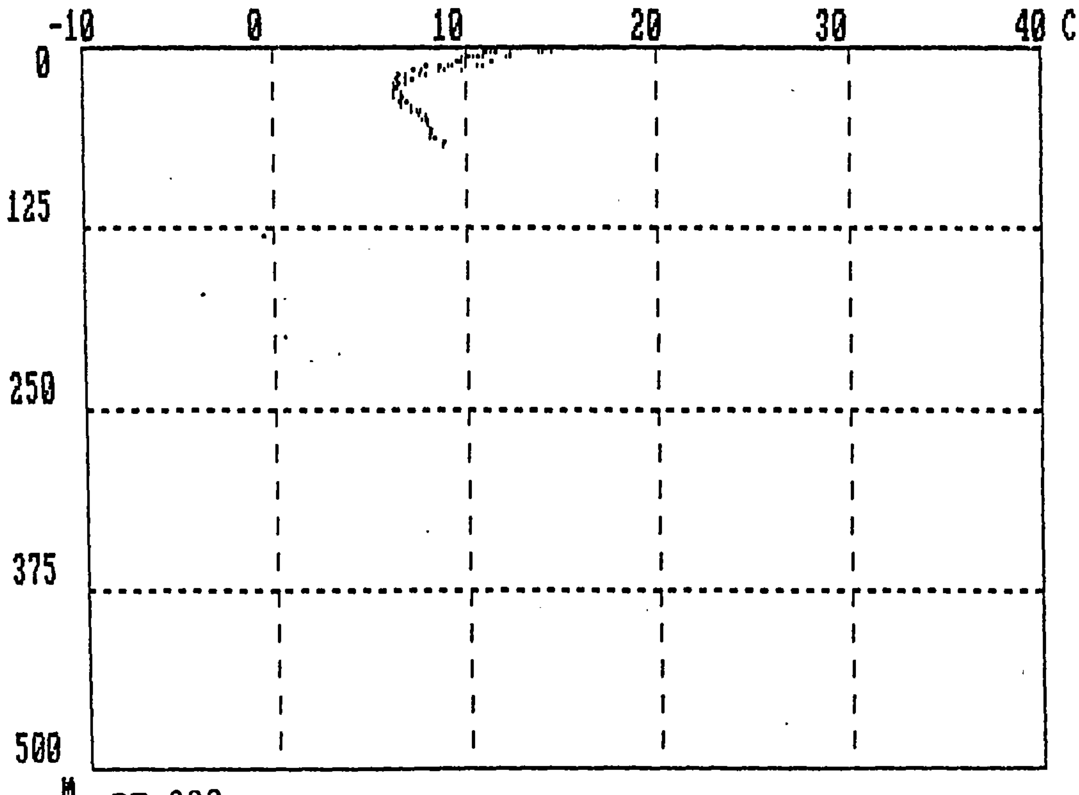
20
30
40 C
0
125
250
375
500
M

BT-007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20
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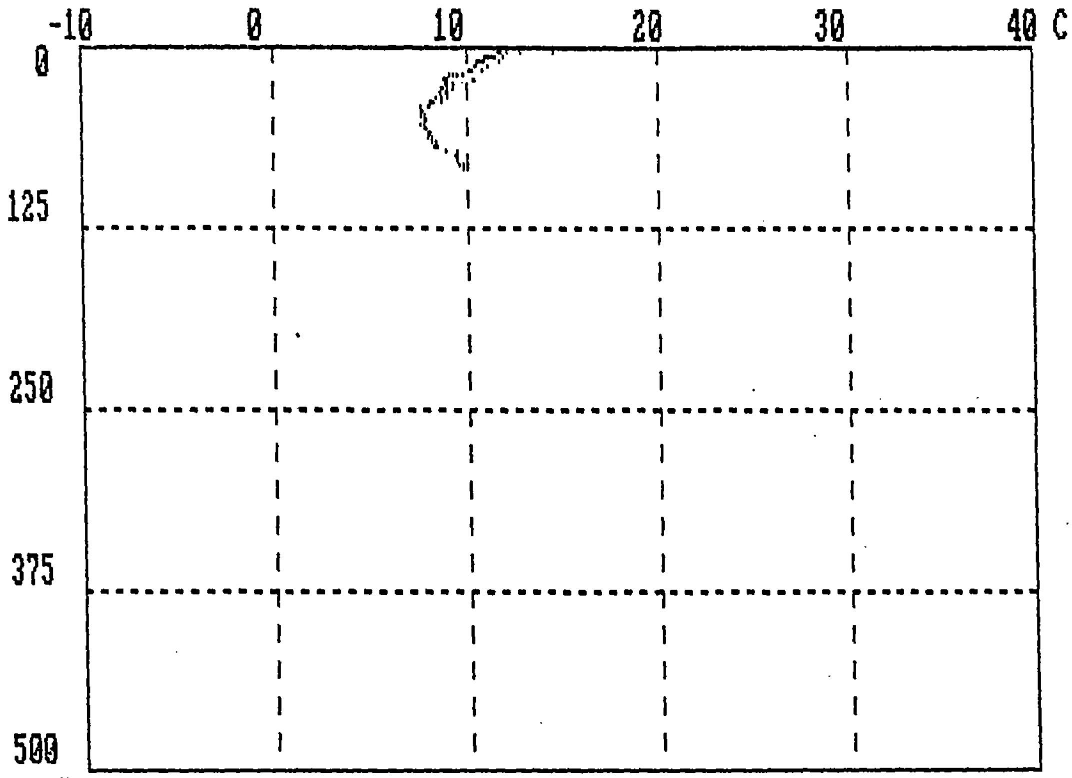
125
250
375
500
M

BT-008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20
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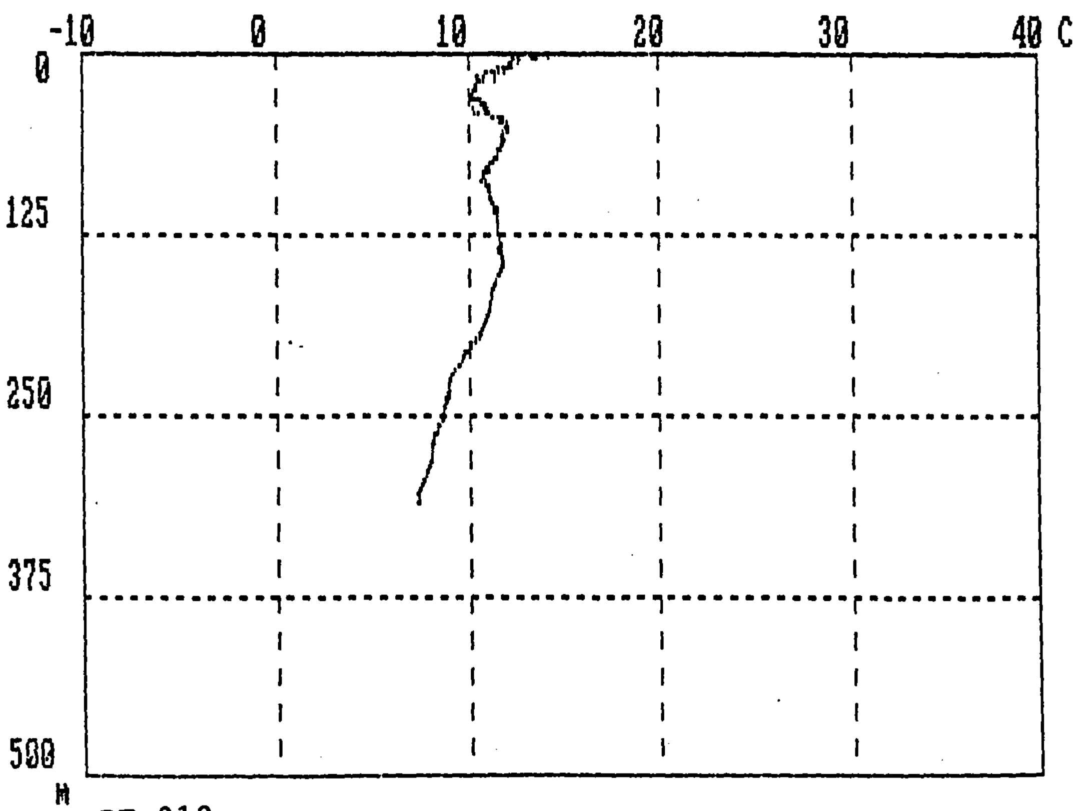
40 C
0
125
250
375
500
M
BT-009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125
250
375
500
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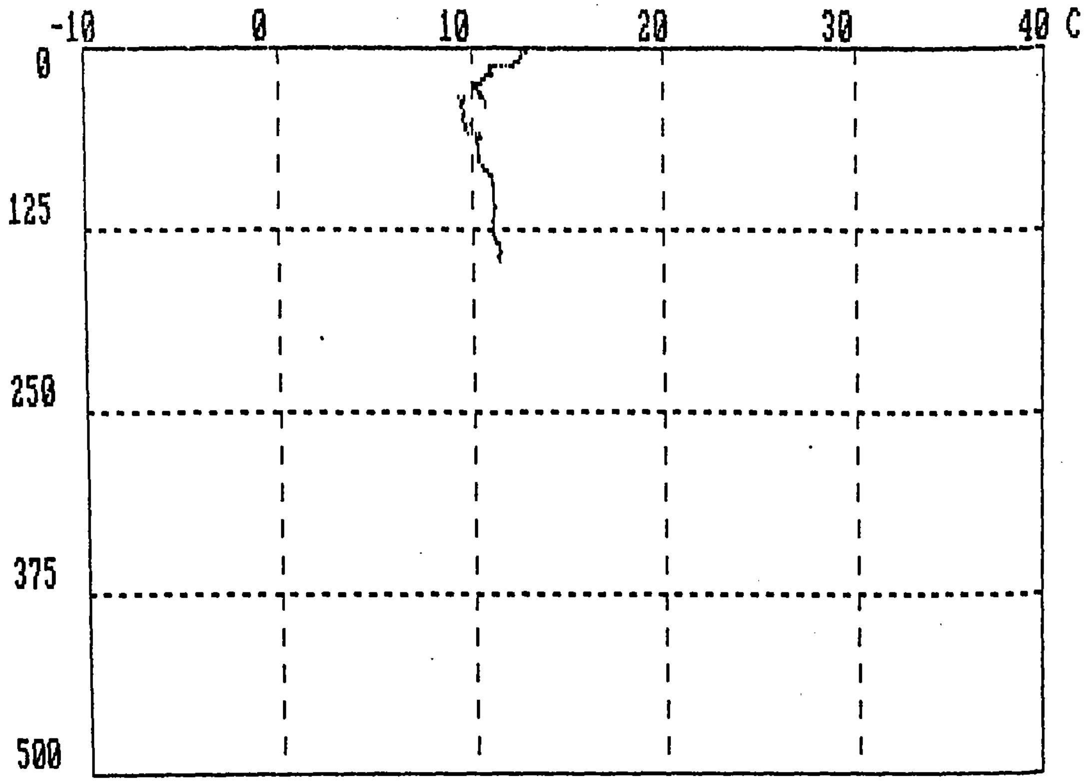
BT-010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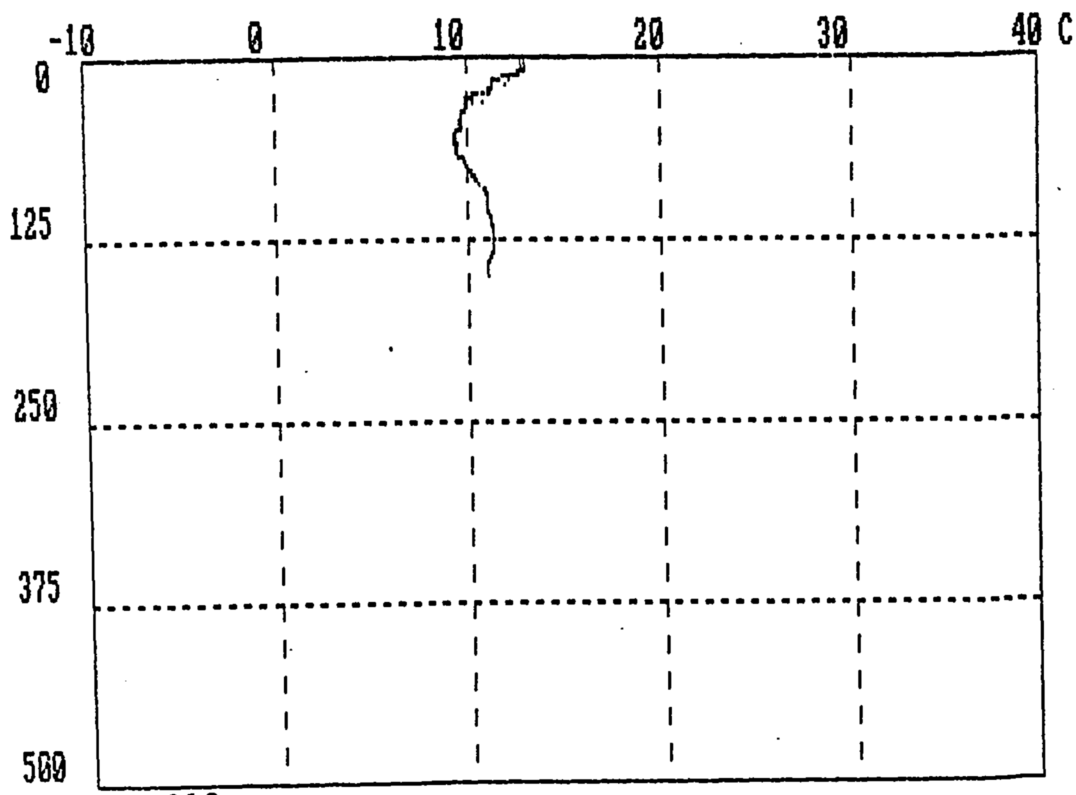
125
250
375
500
M

BT-011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125
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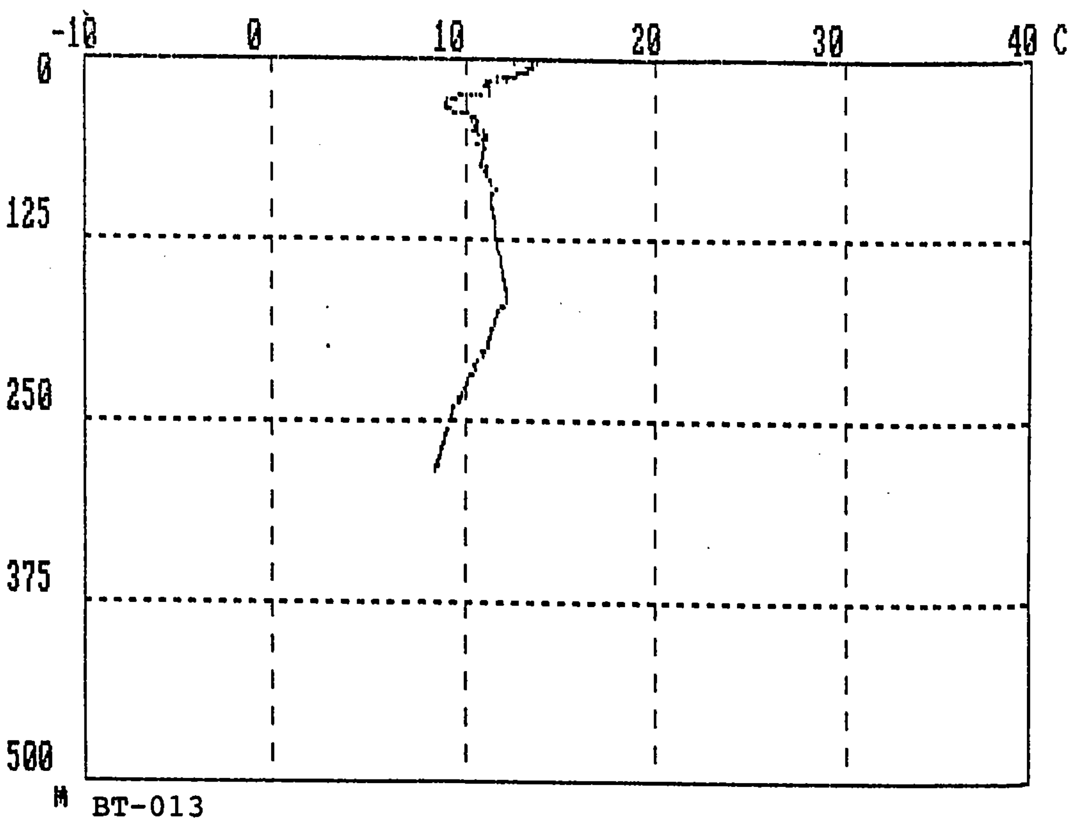
BT-012



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40 C
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125
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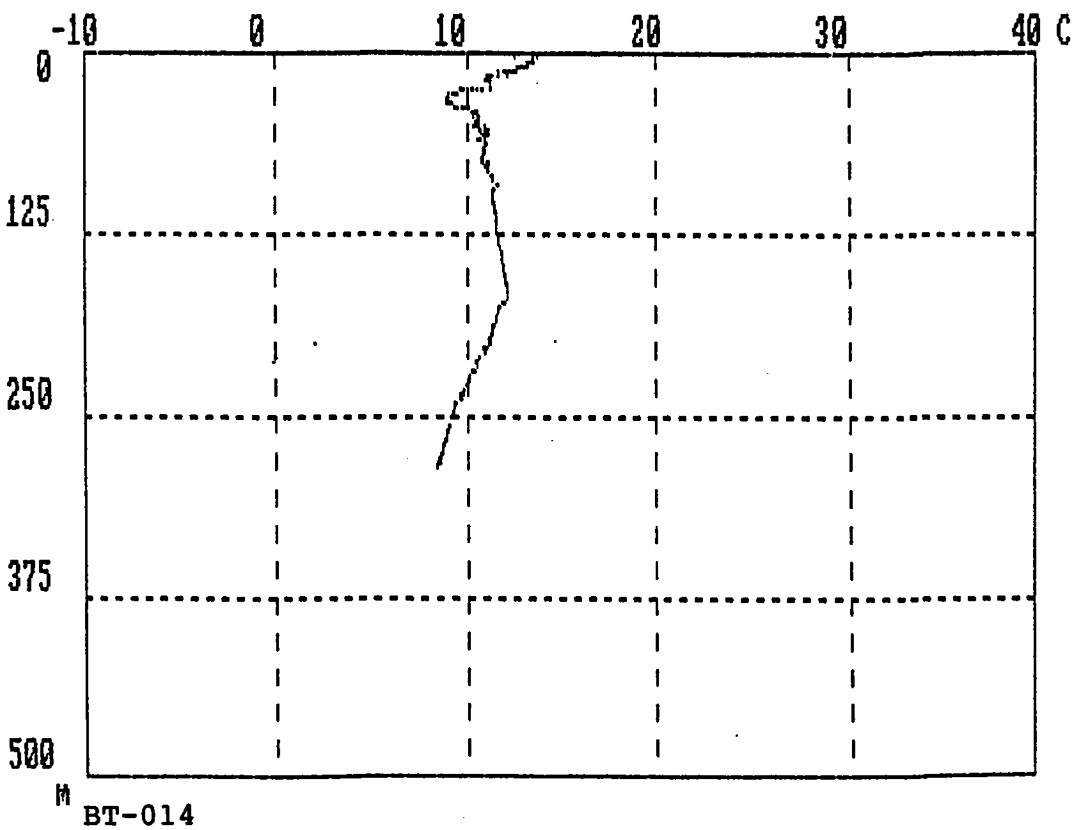
375
500
M
BT-013



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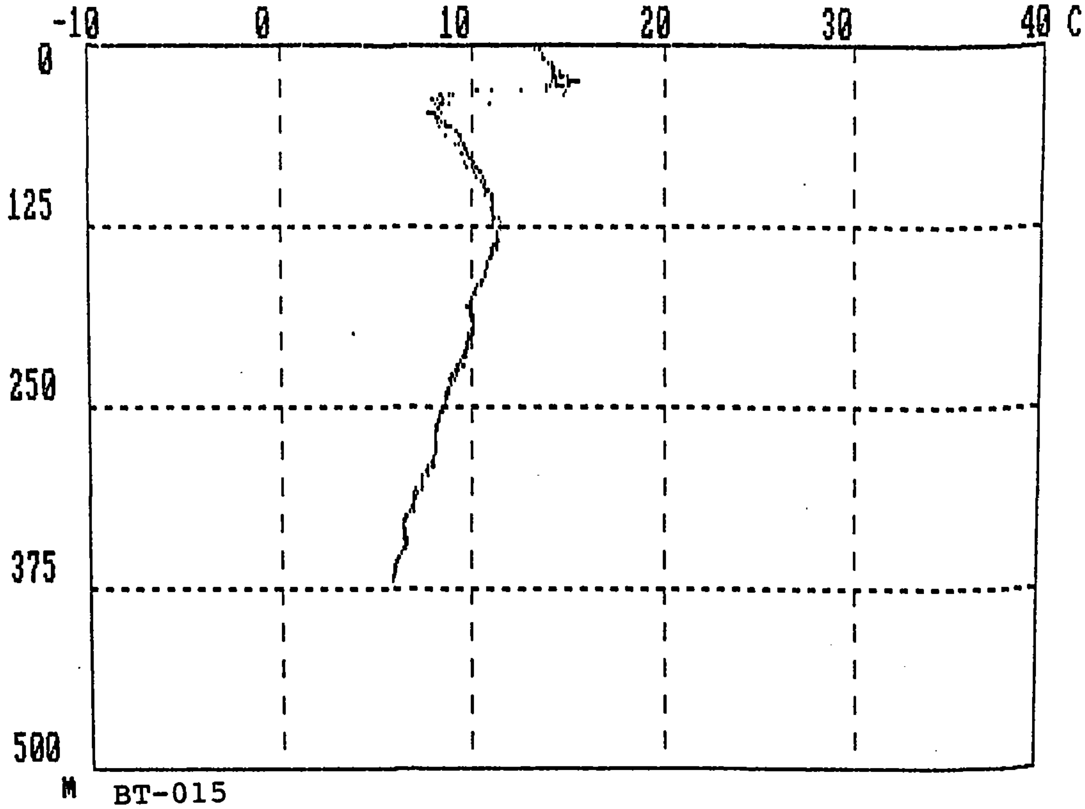
BT-014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125
250
375
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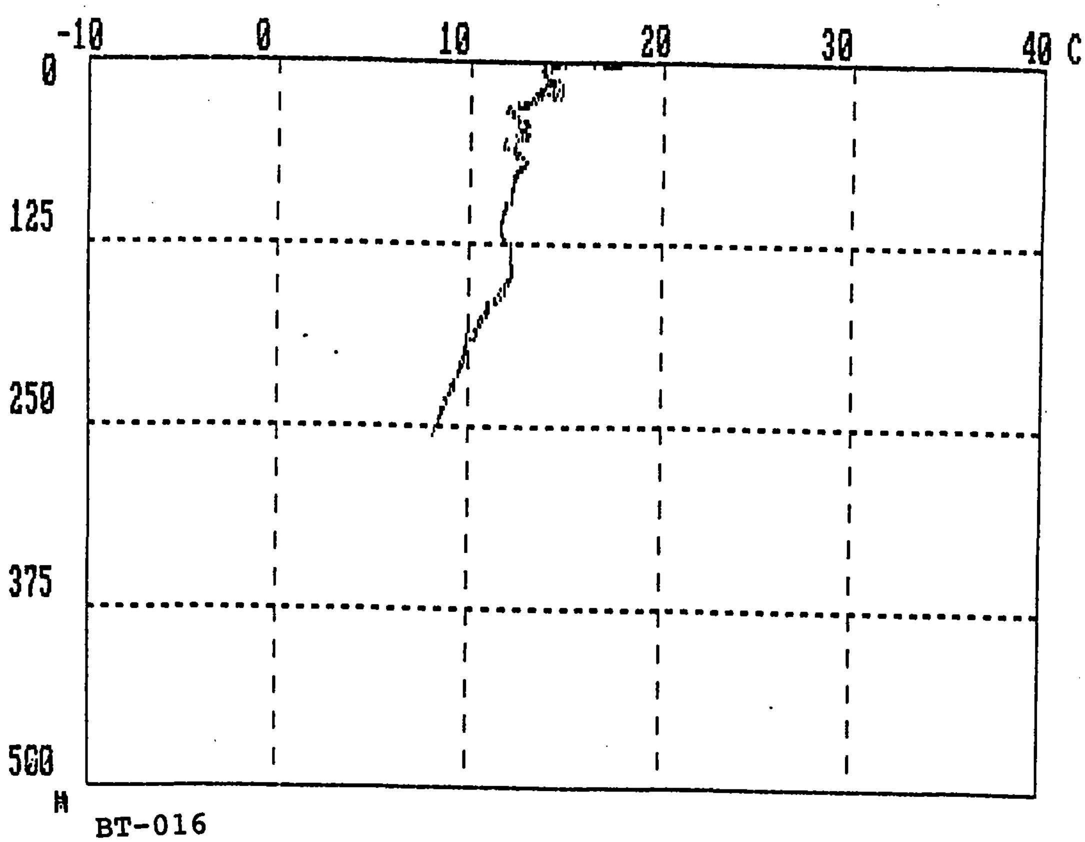
BT-015


-10
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30
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125
250
375
500
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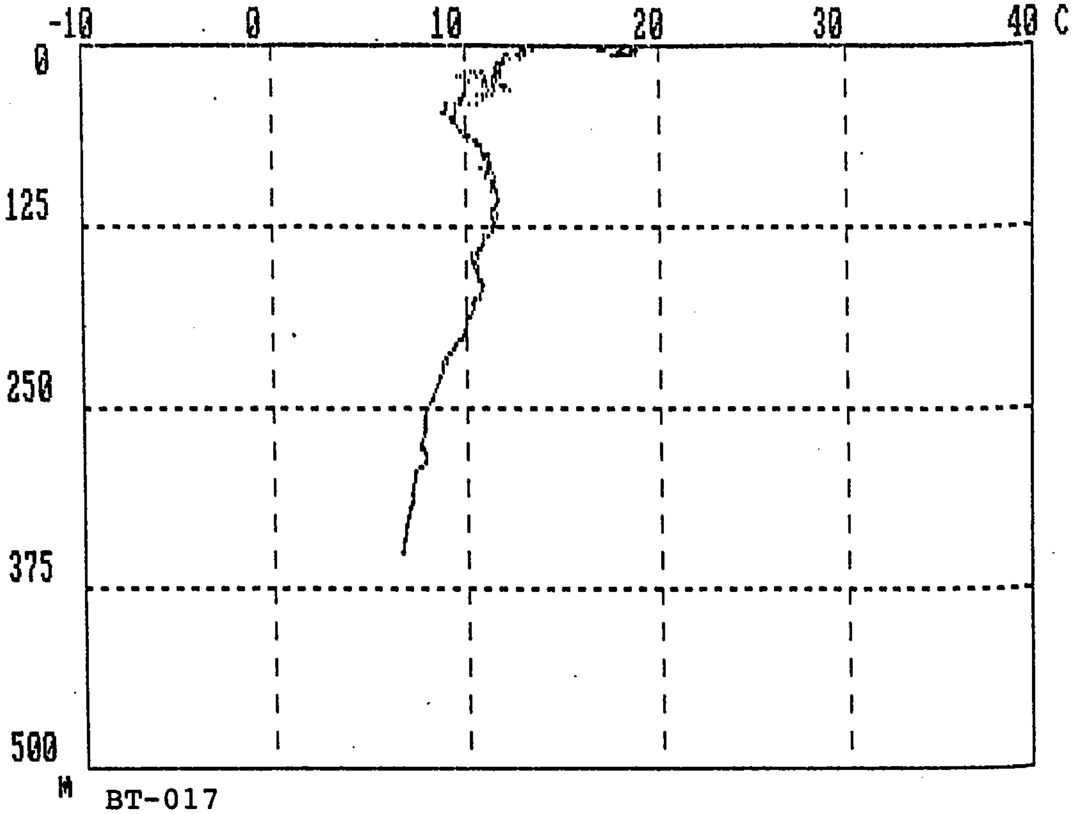
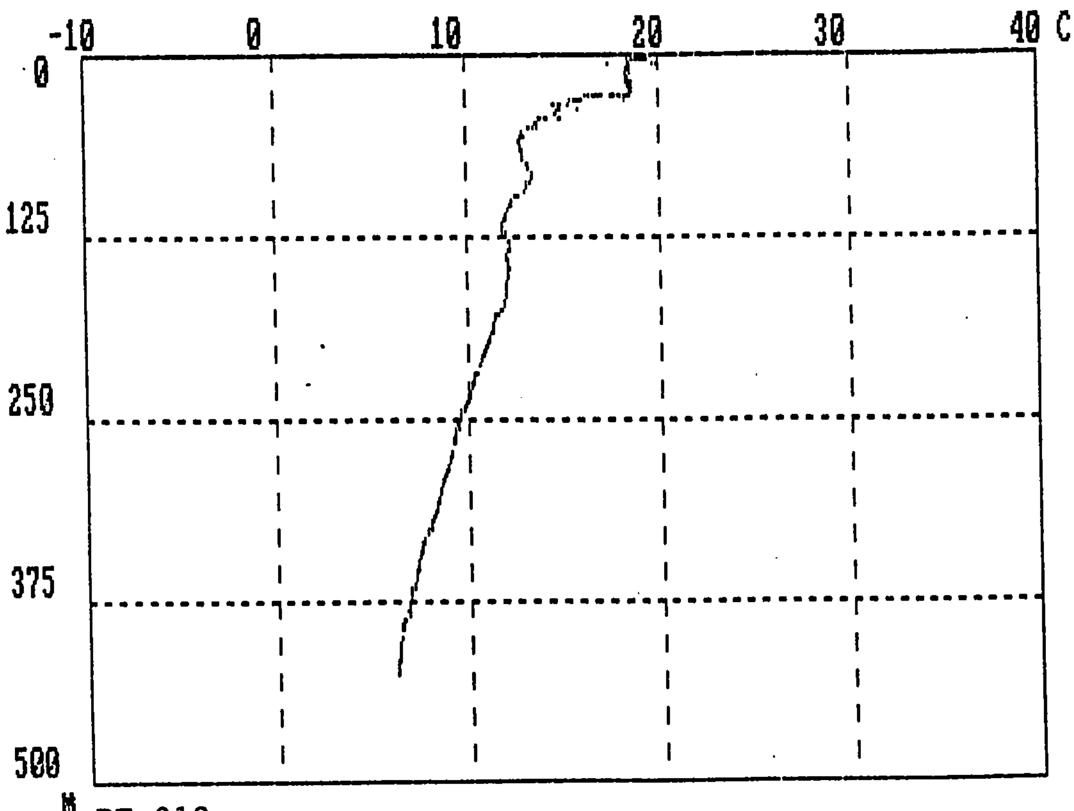
BT-016



-10
0
10
20
30
40 C
0
125
250
375
500
M

BT-017



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40 C
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125
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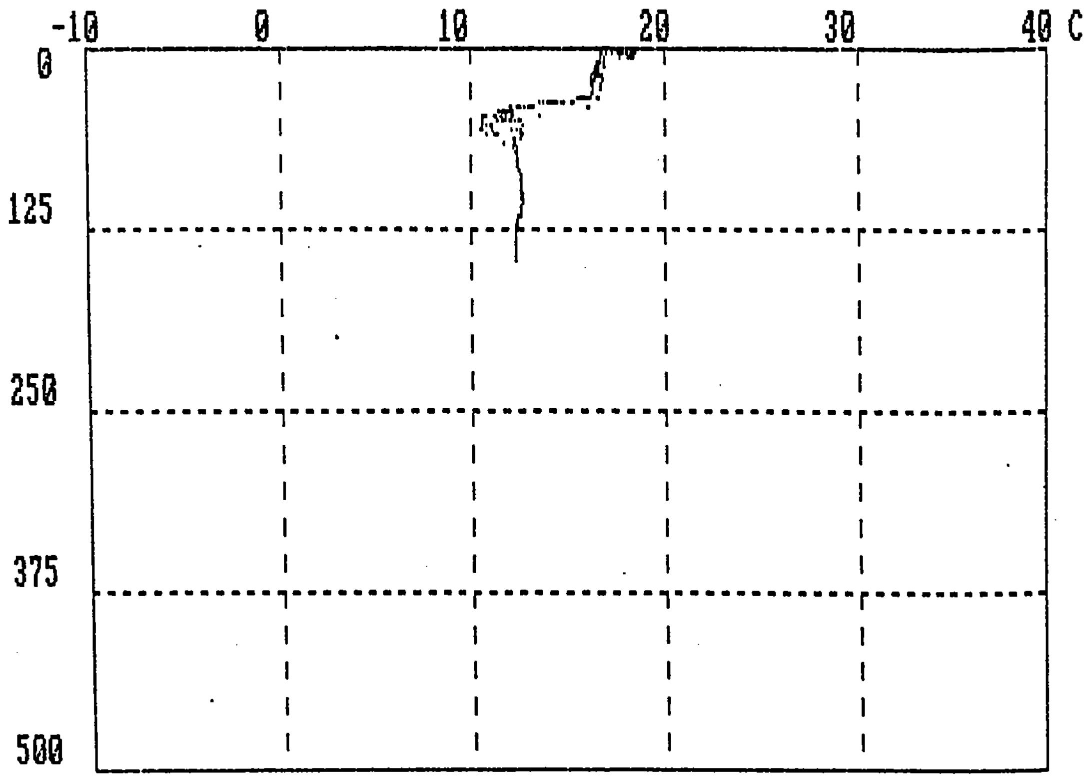
375
500
M

BT-018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375
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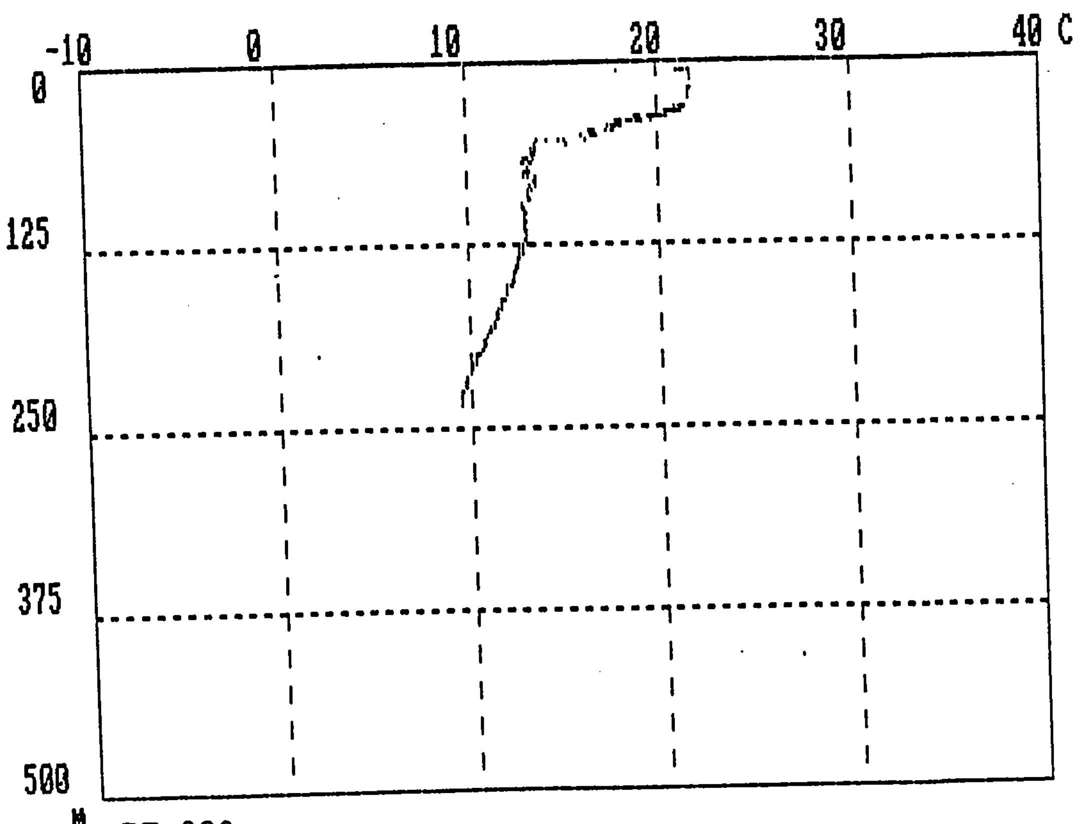
M

BT-019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40 C
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125
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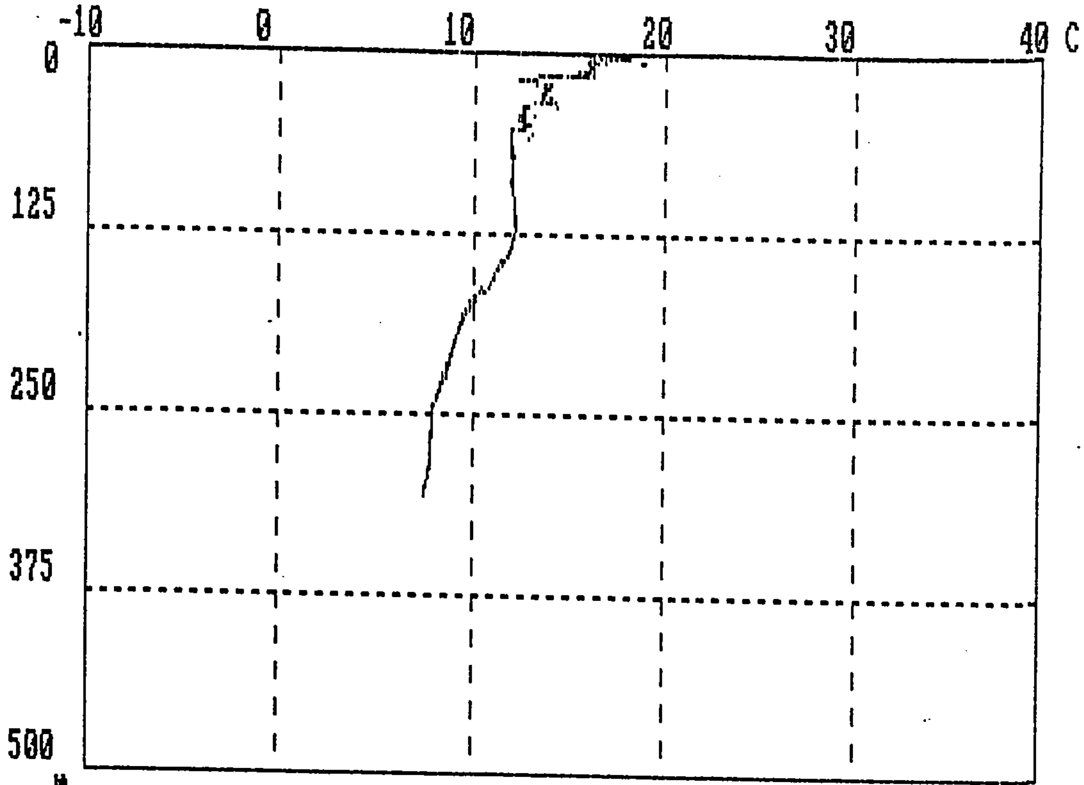
375
500
M

BT-020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40 C
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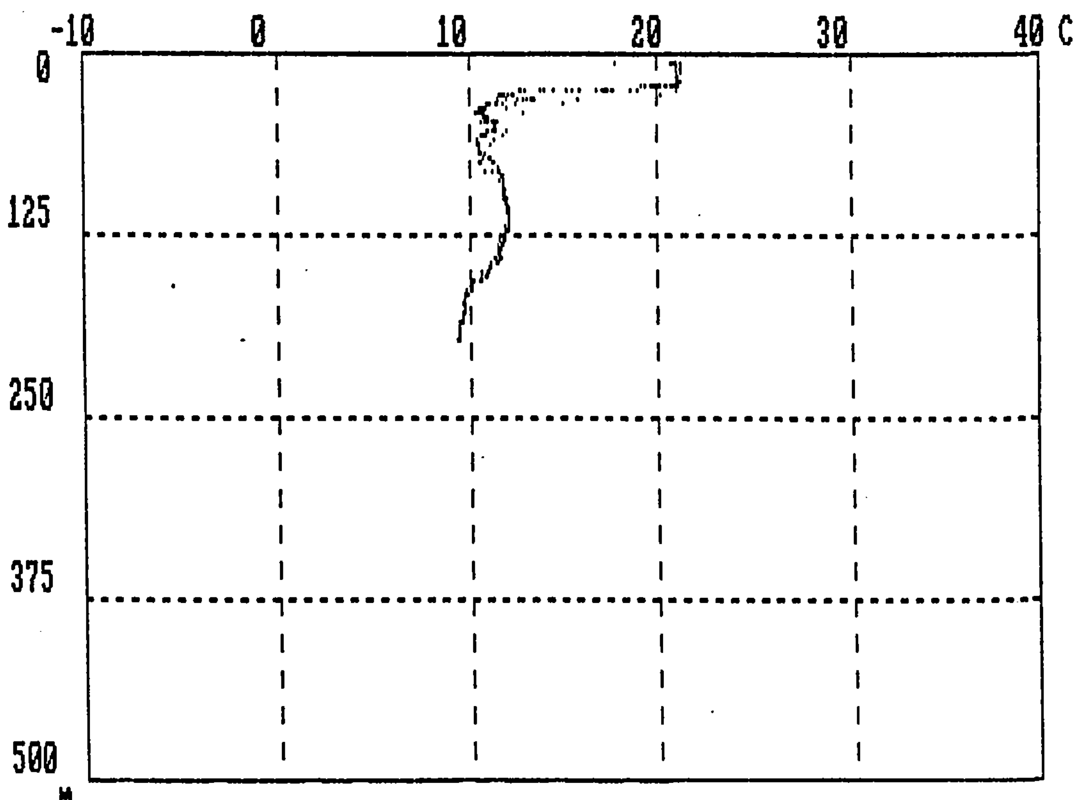
125
250
375
500
M
BT-021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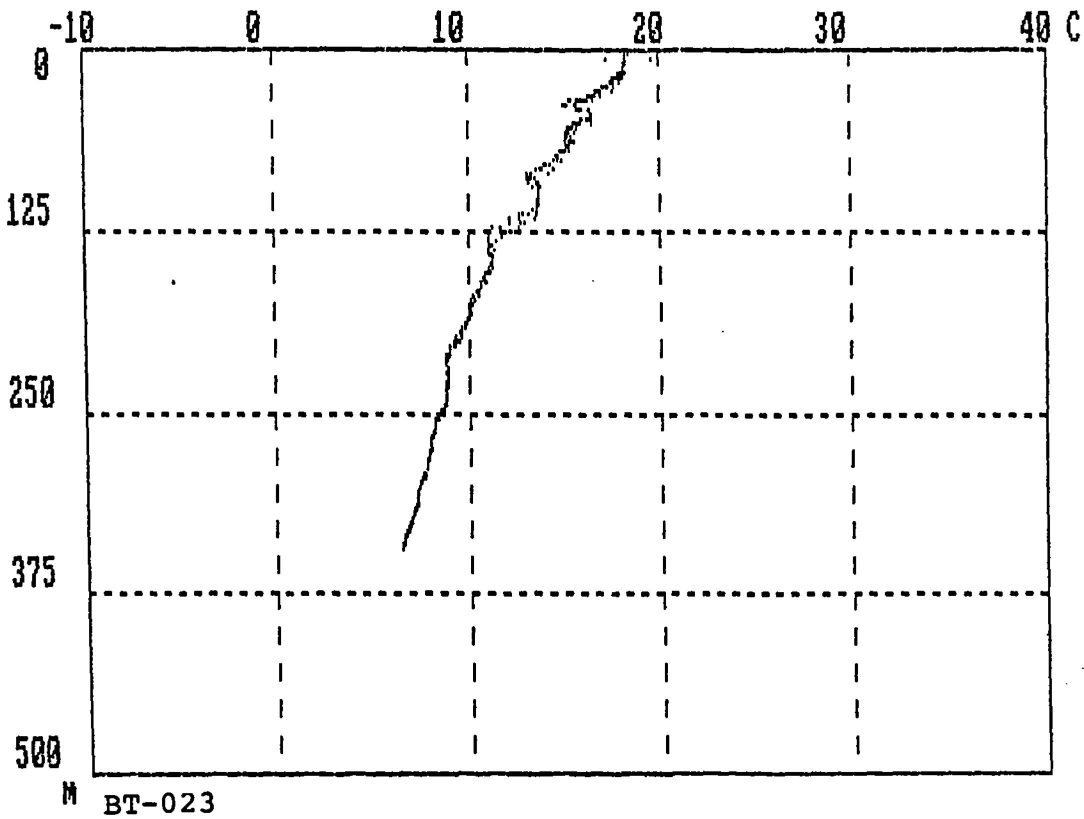
375
500
M
BT-022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500
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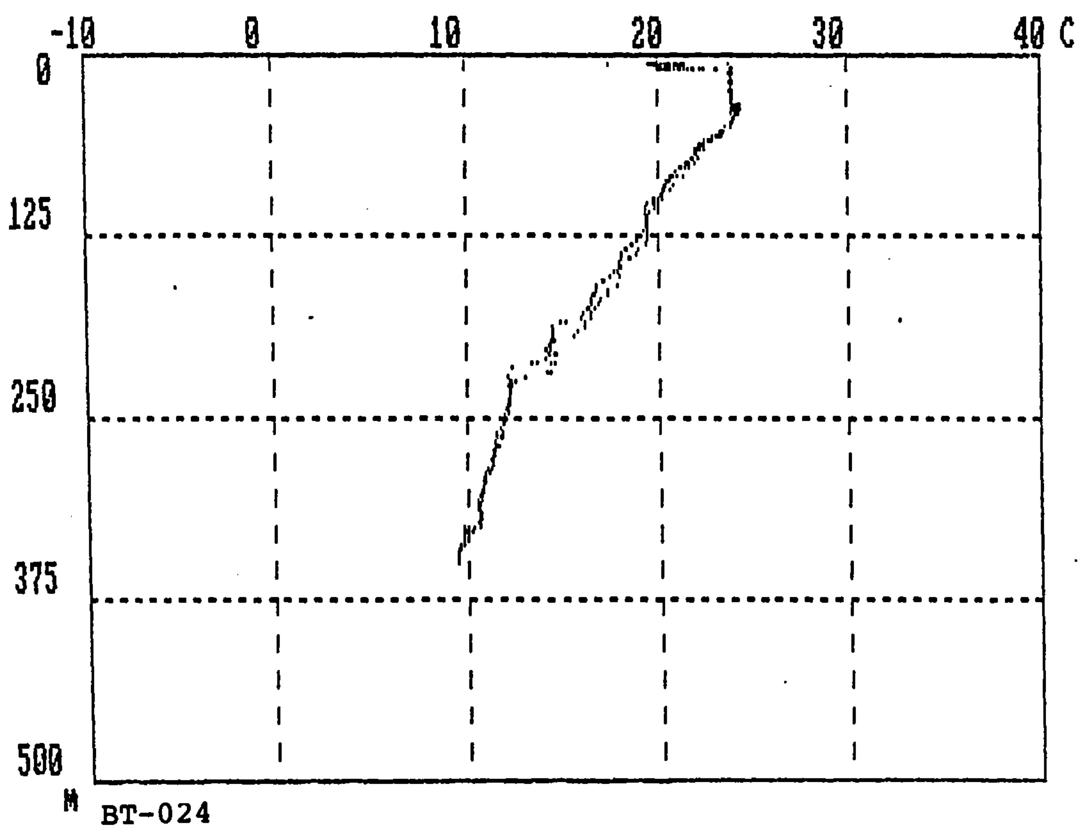
BT-023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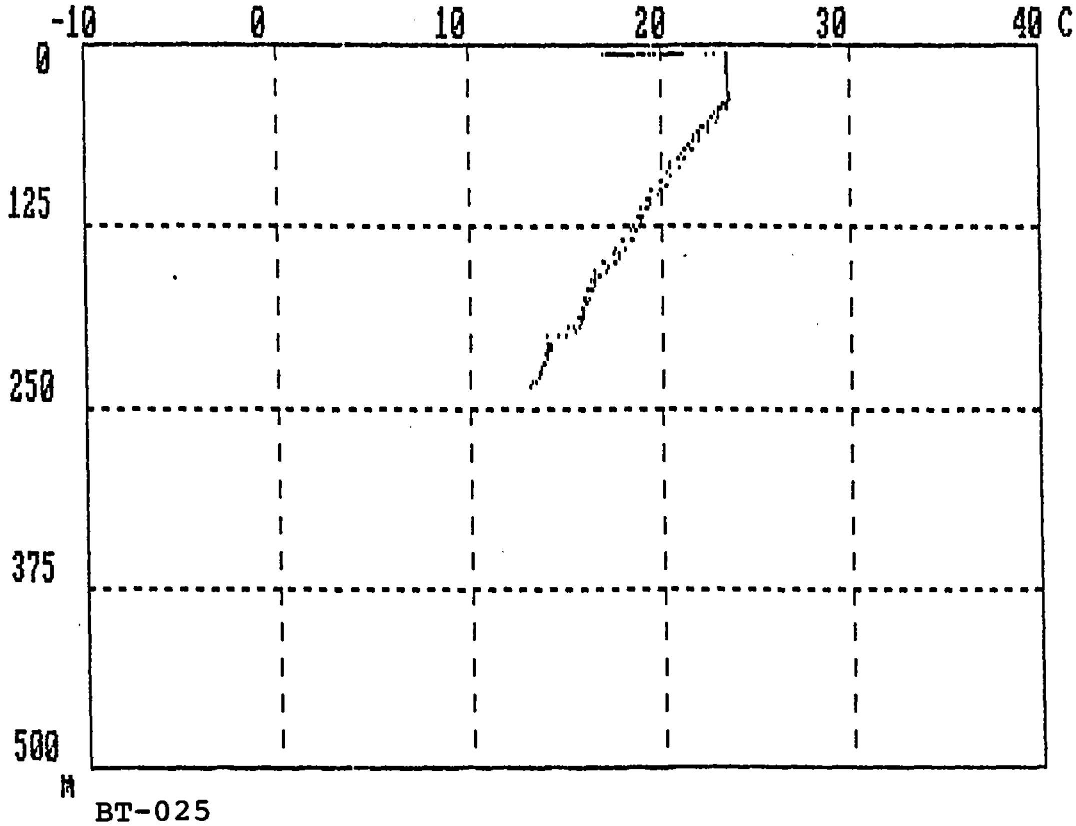
375
500
M
BT-024



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40 C
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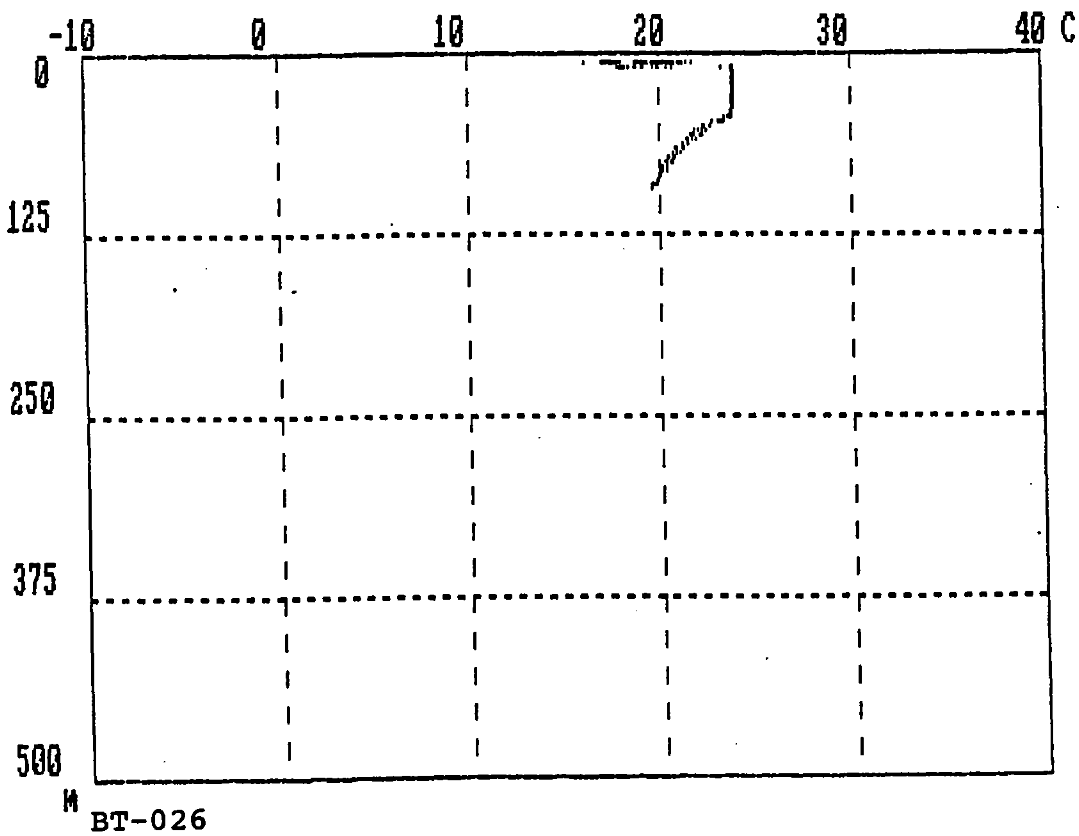
250
375
500
M
BT-025



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20
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40 C
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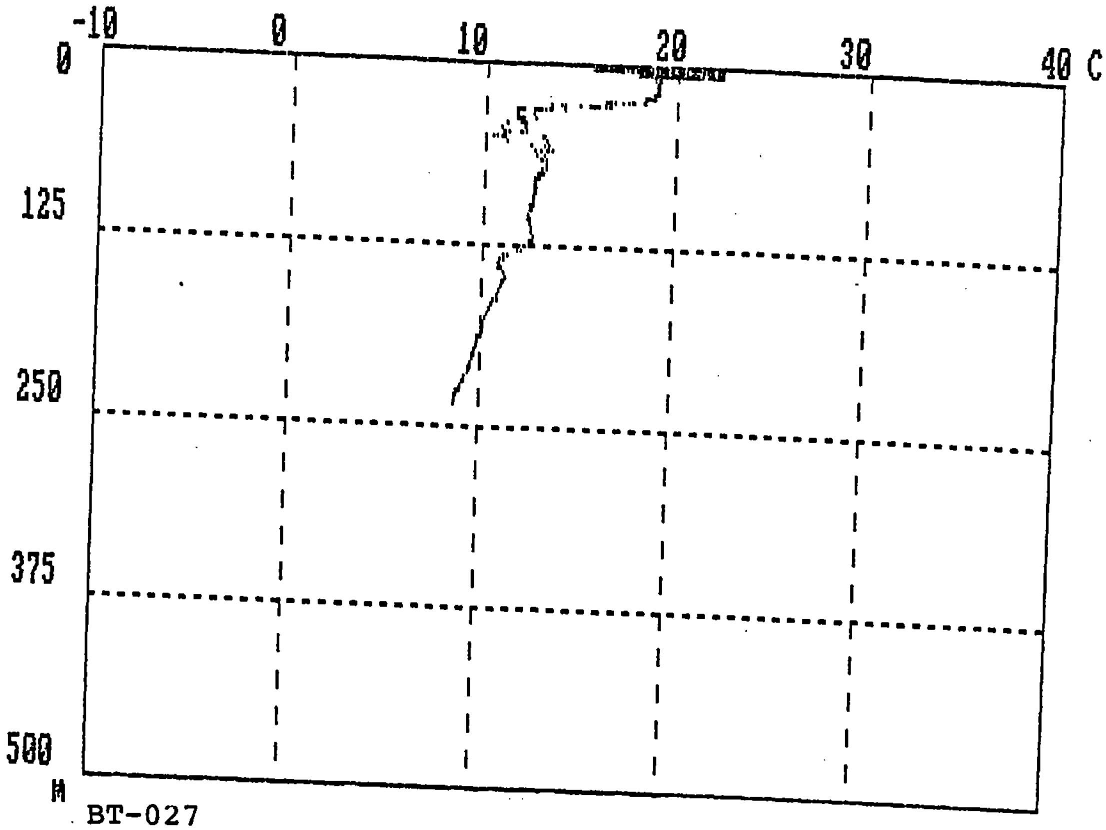
125
250
375
500
M
BT-026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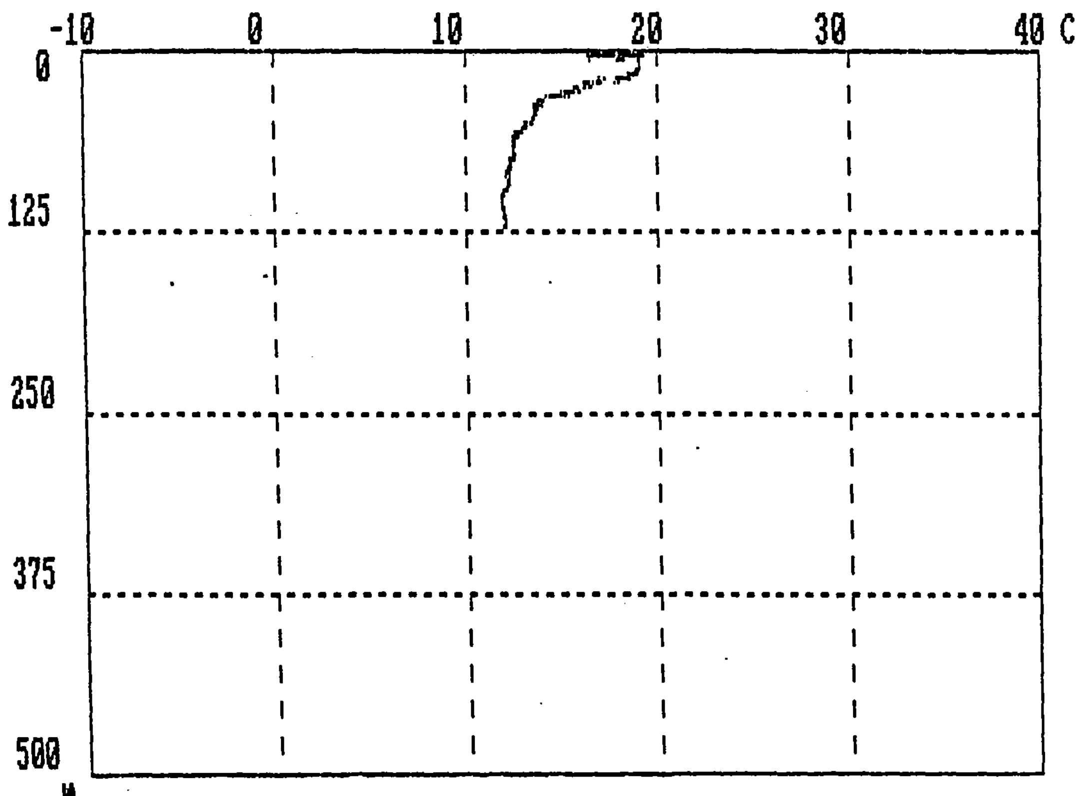
125
250
375
500
M

BT-027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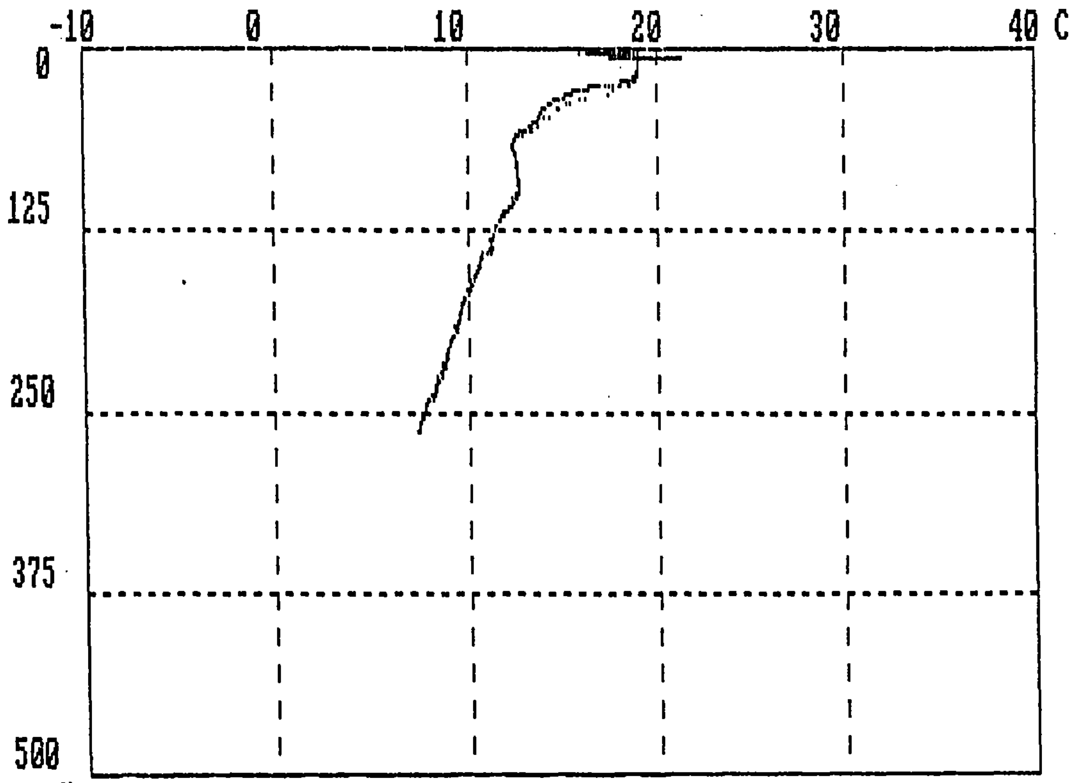
0
10
20
30
40 C
0
125
250
375
500
M

BT-028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0
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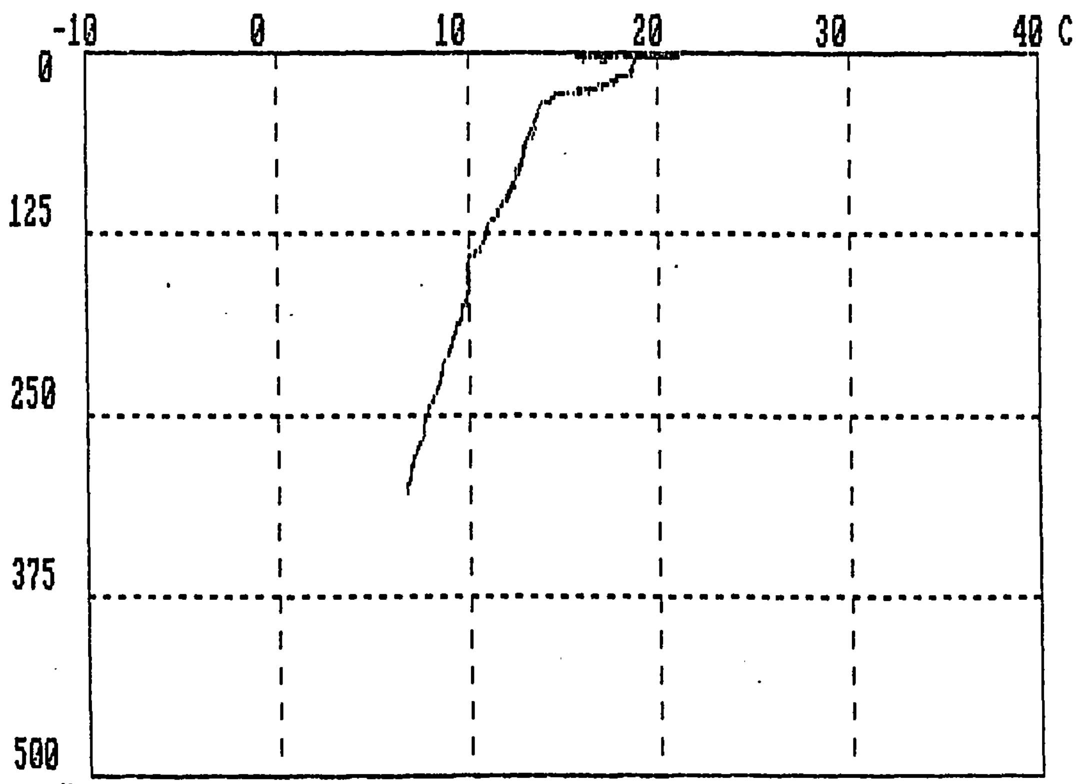
30
40 C
0
125
250
375
500
M

BT-029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0
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20
30
40 C
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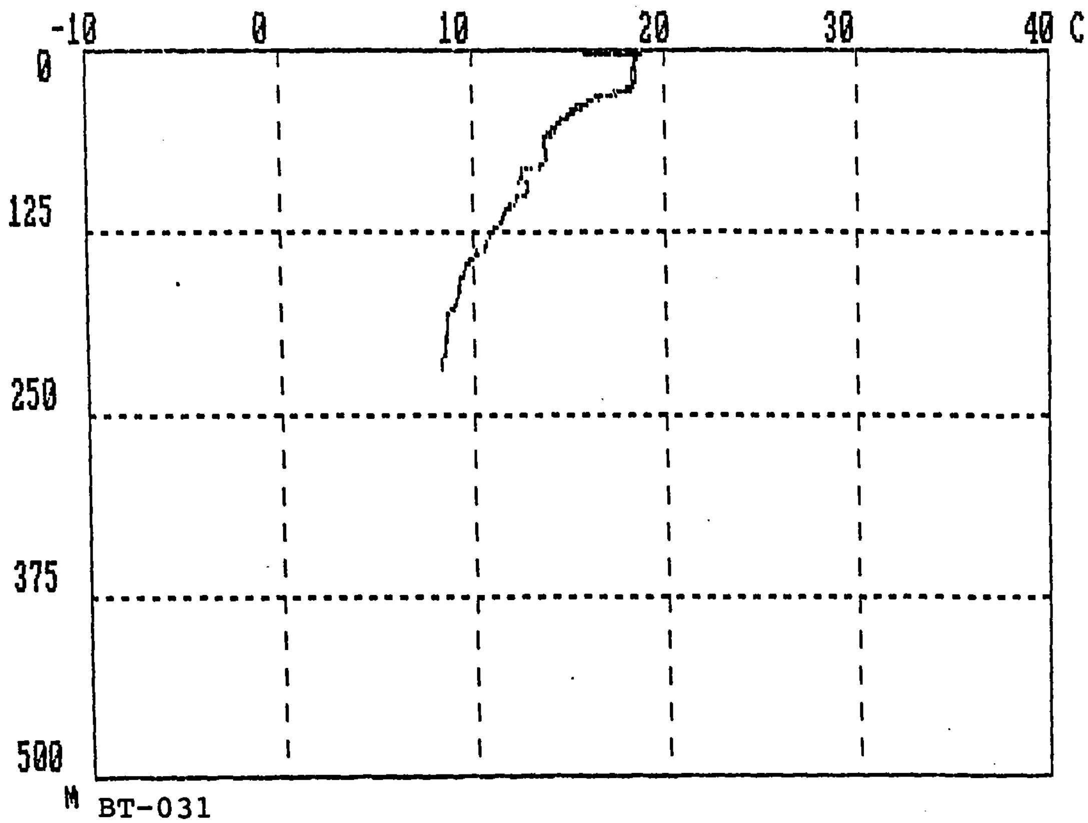
125
250
375
500
M

BT-030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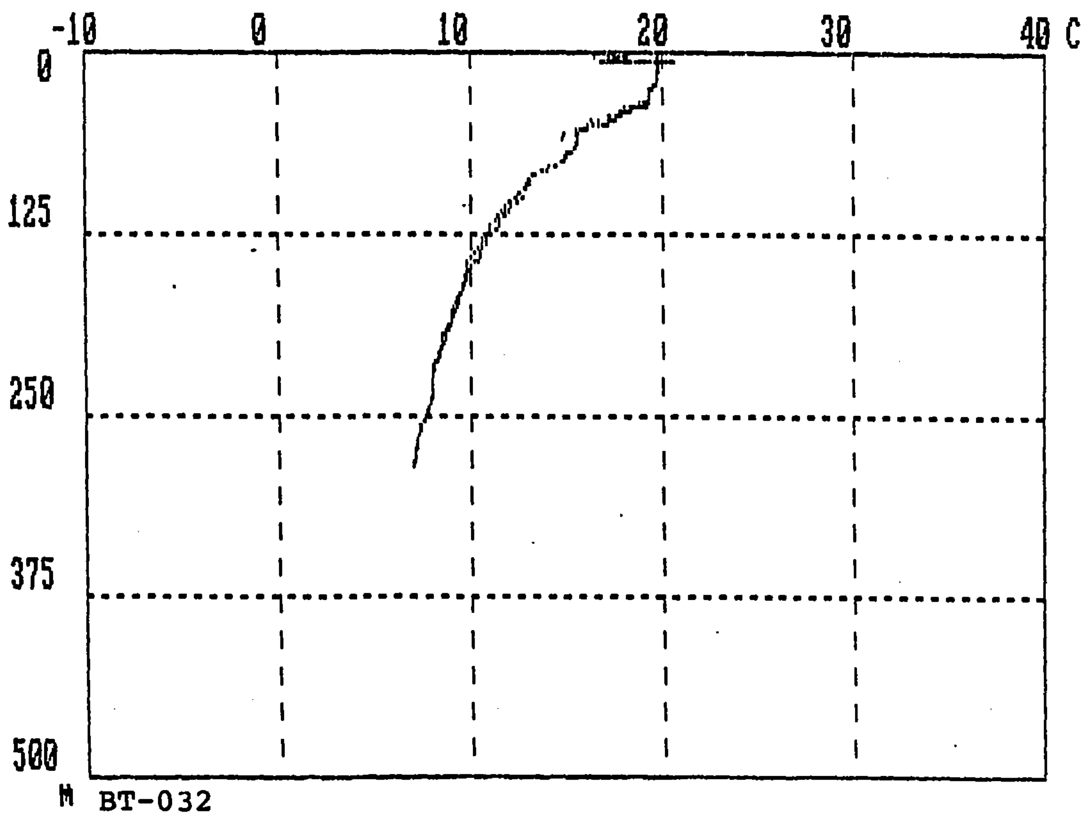
0
10
20
30
40 C
0
125
250
375
500
M
BT-031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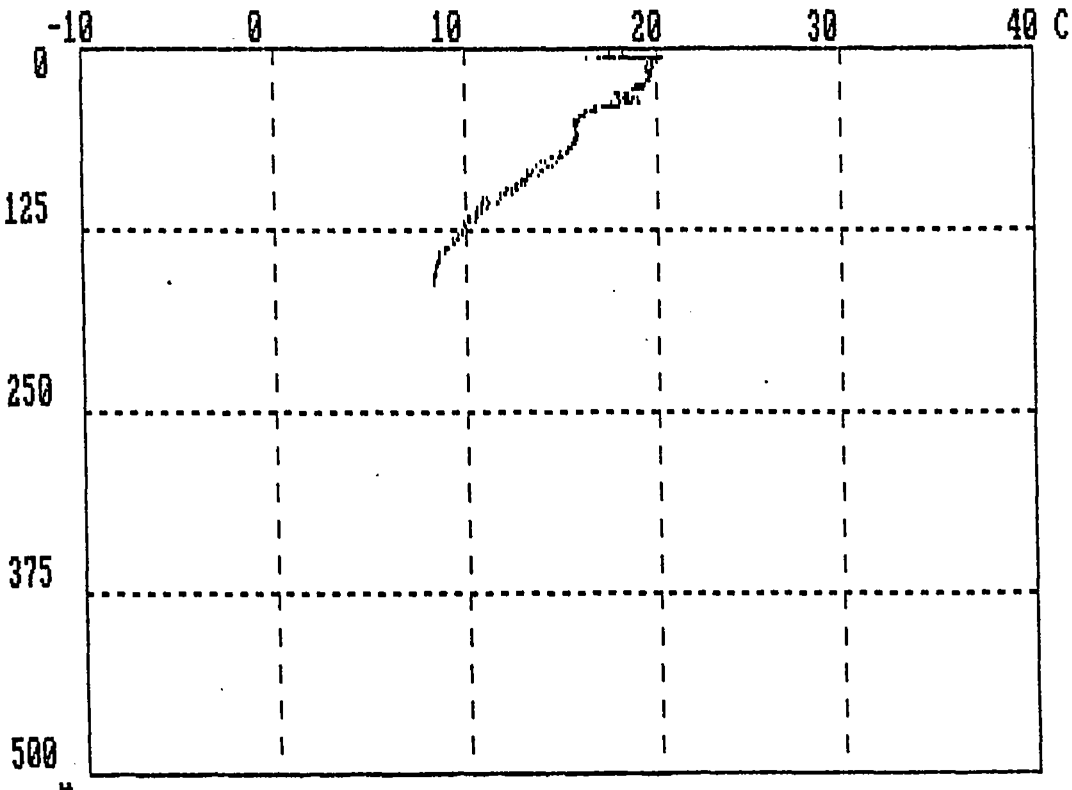
0
10
20
30
40 C
0
125
250
375
500
M
BT-032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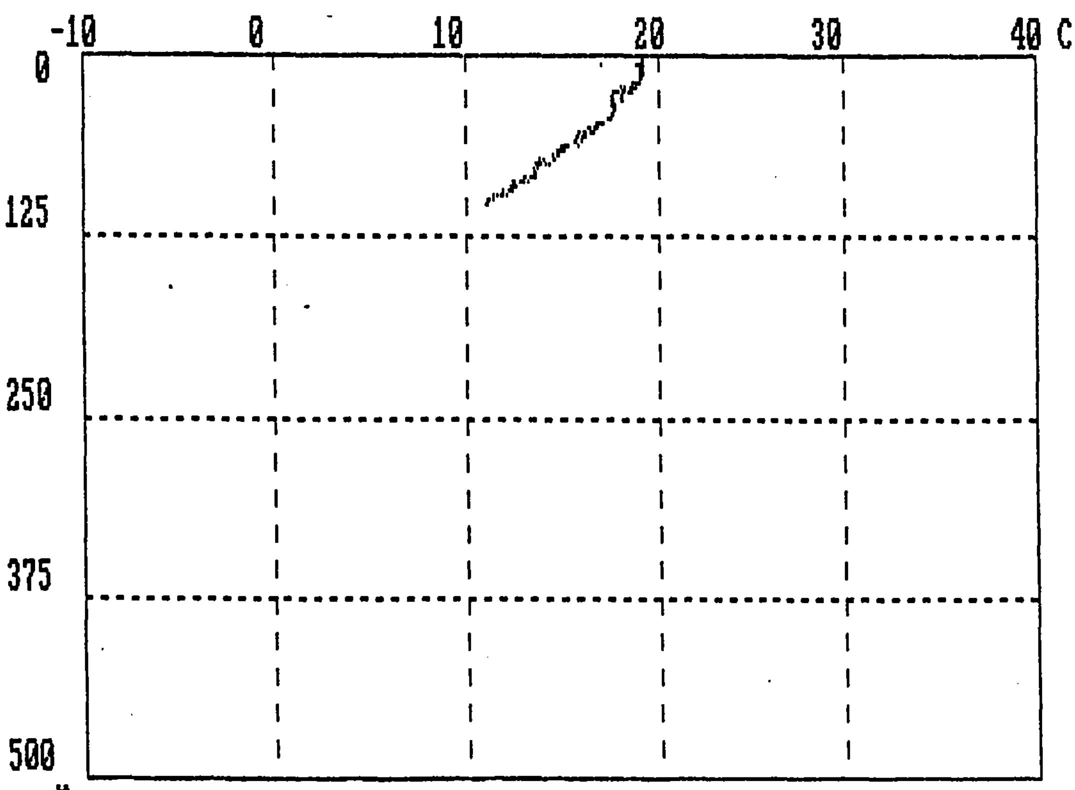
0
10
20
30
40 C
0
125
250
375
500
M
BT-033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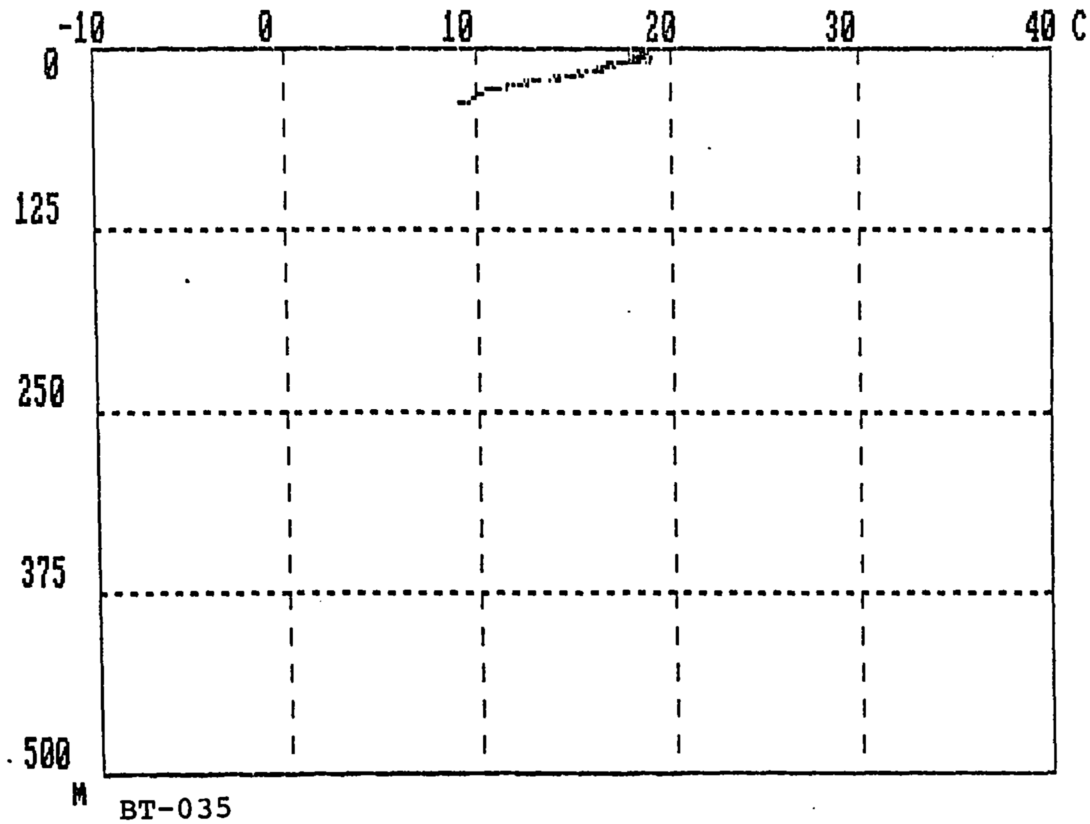
0
10
20
30
40 C
0
125
250
375
500
M
BT-034



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0
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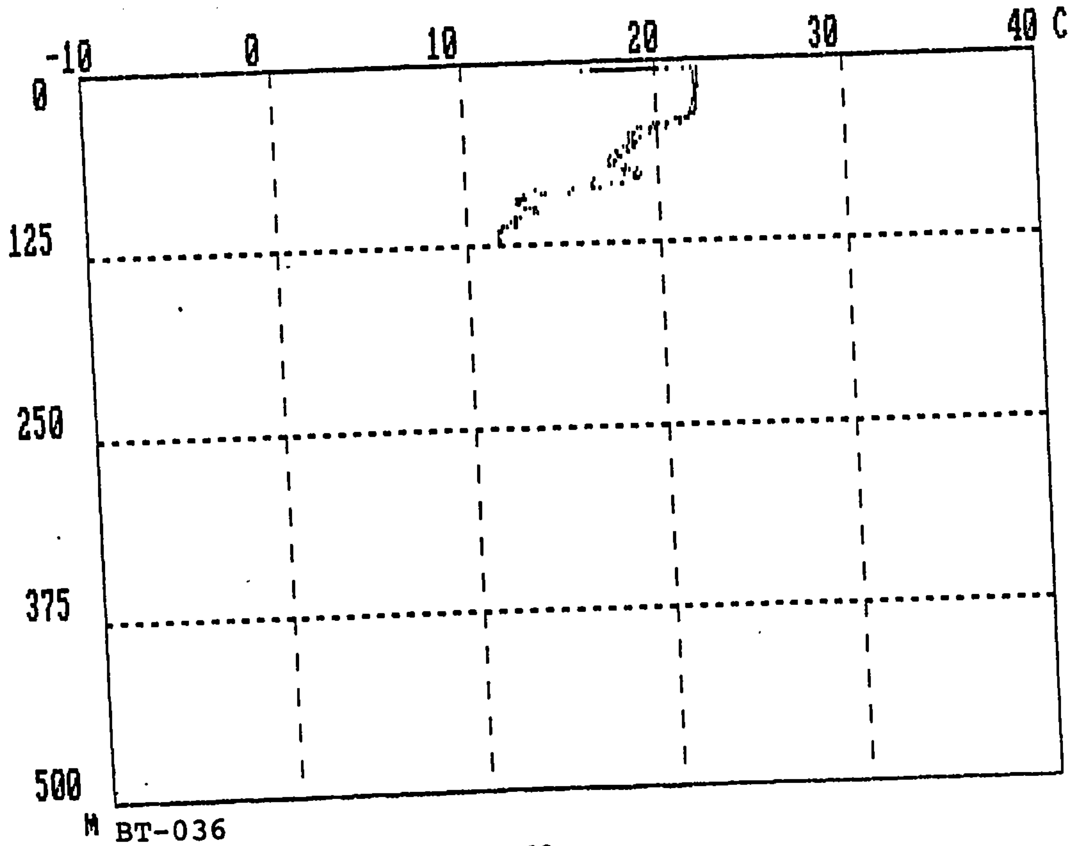
20
30
40 C
0
125
250
375
500
M
BT-035



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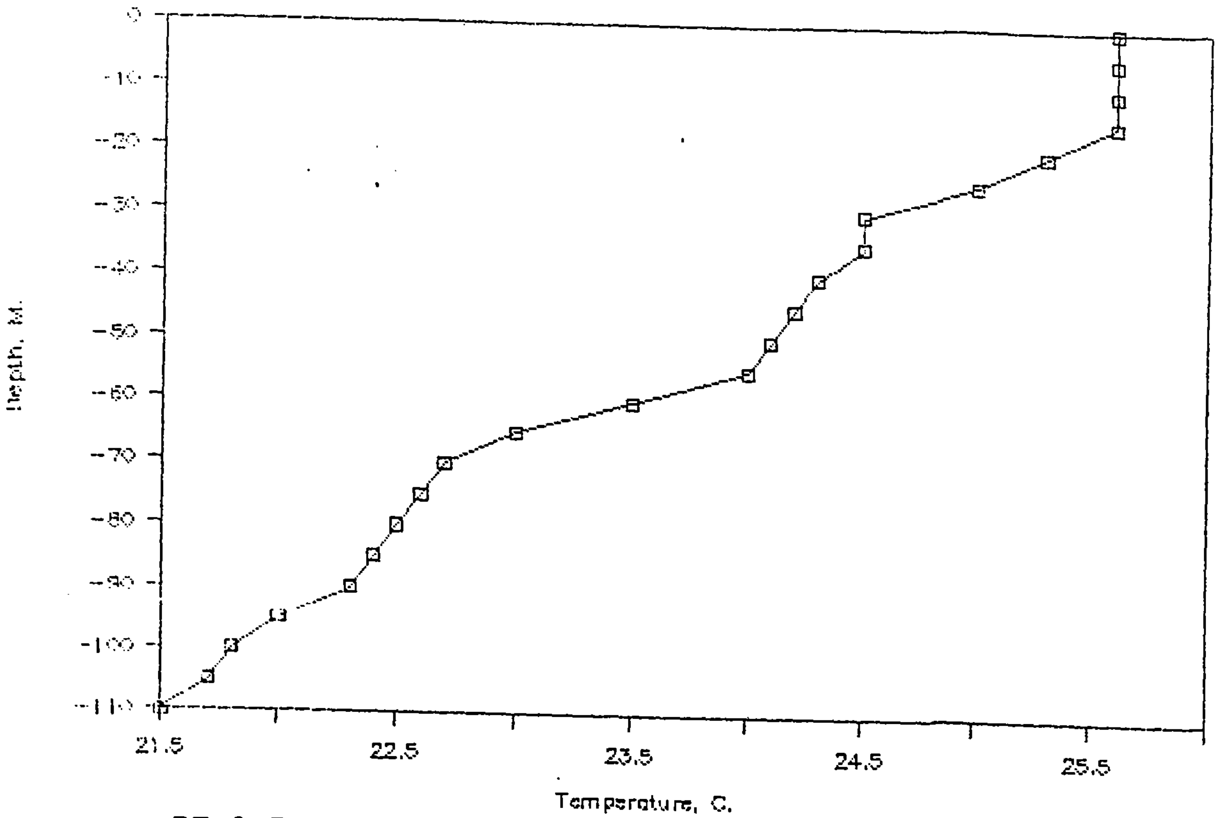
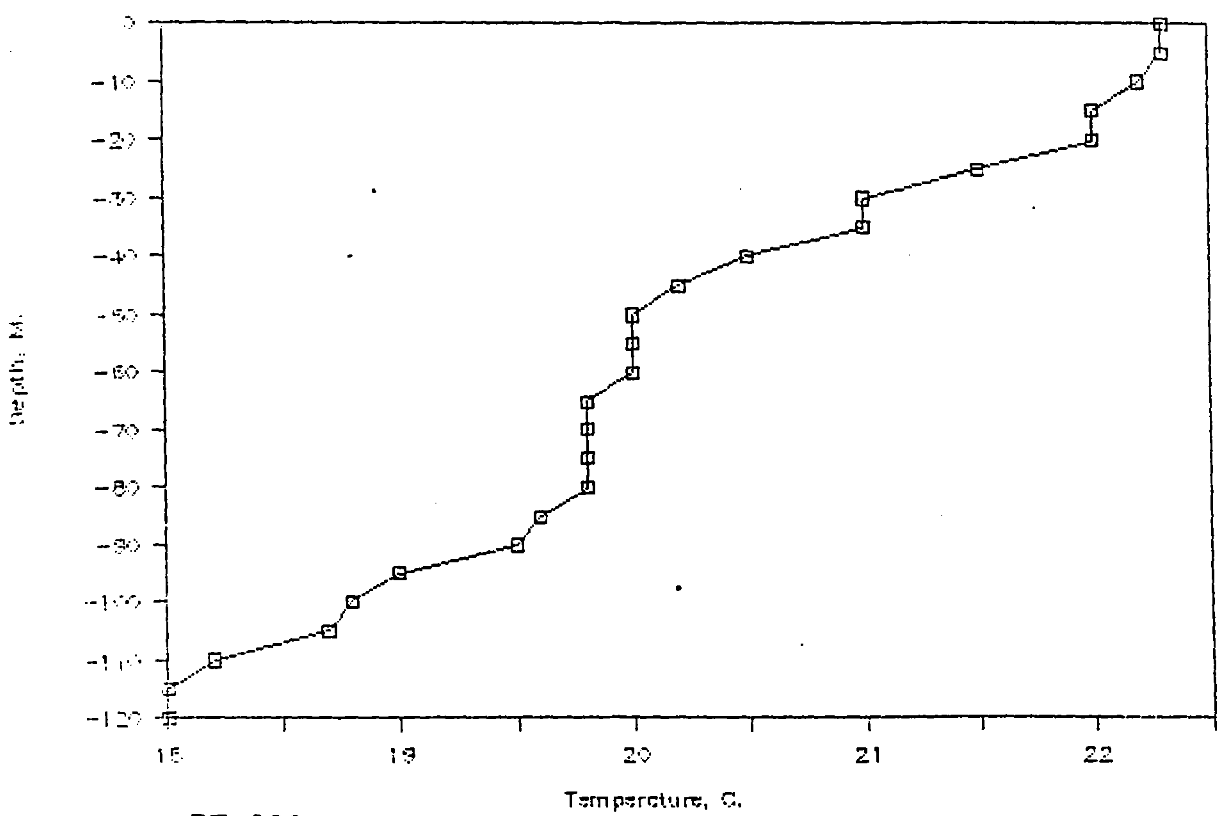
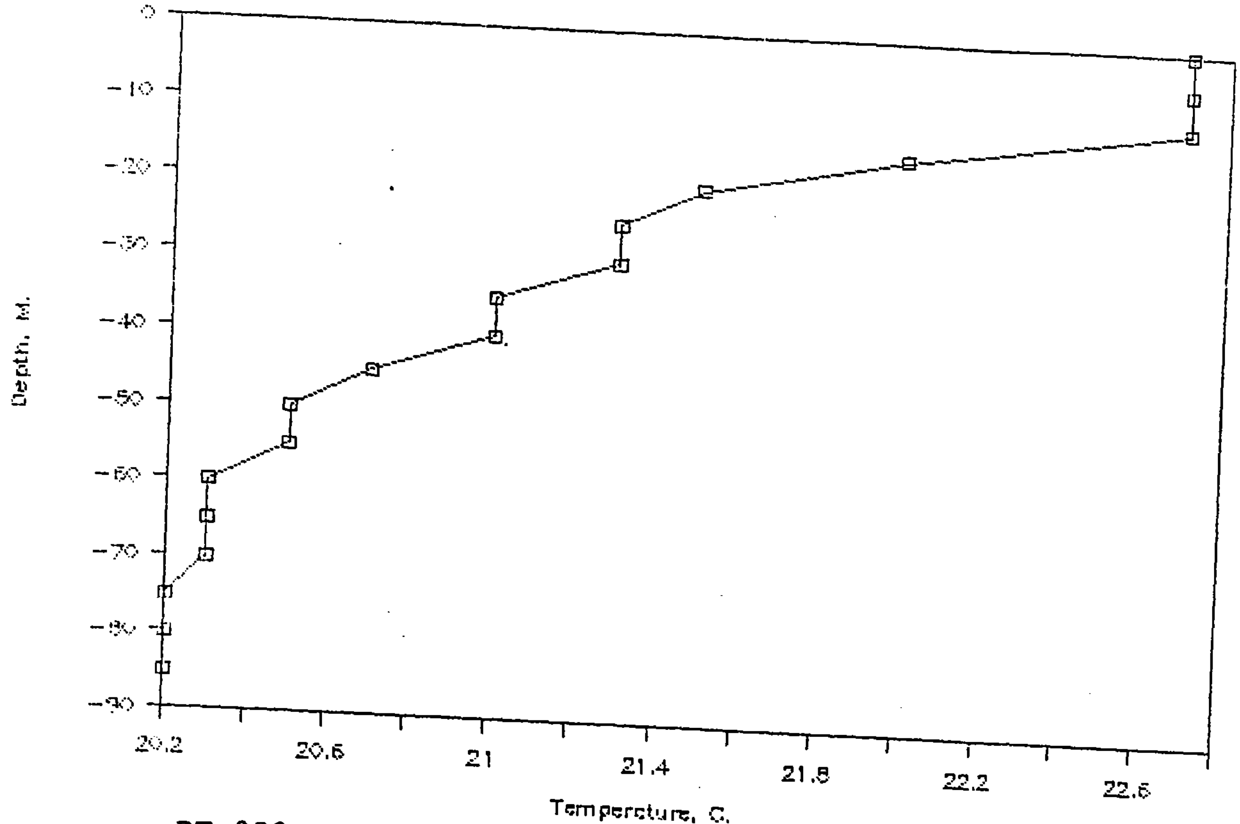
0
10
20
30
40 C
0
125
250
375
500
M
BT-036


0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
Depth, M.
21.5
22.5
23.5
24.5
25.5
Temperature, C.

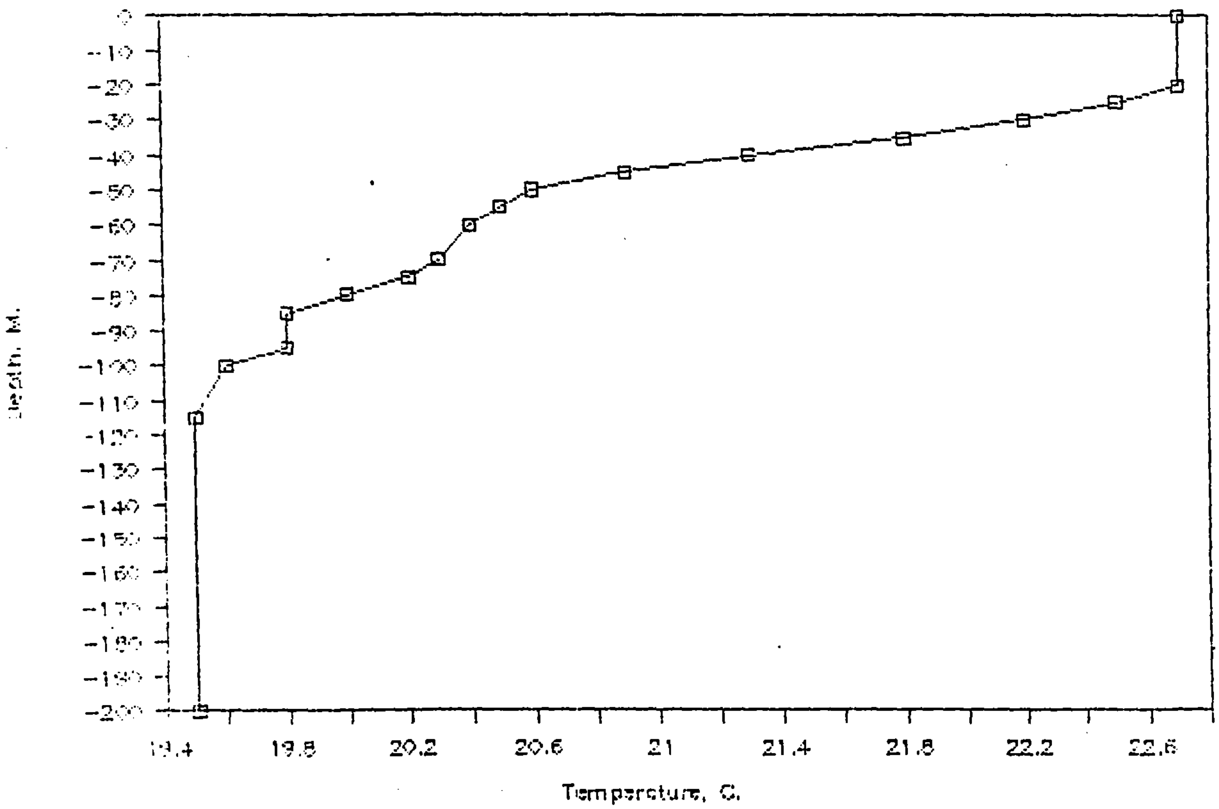
BT-037


0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Depth, M.
18
19
20
21
22
Temperature, C.

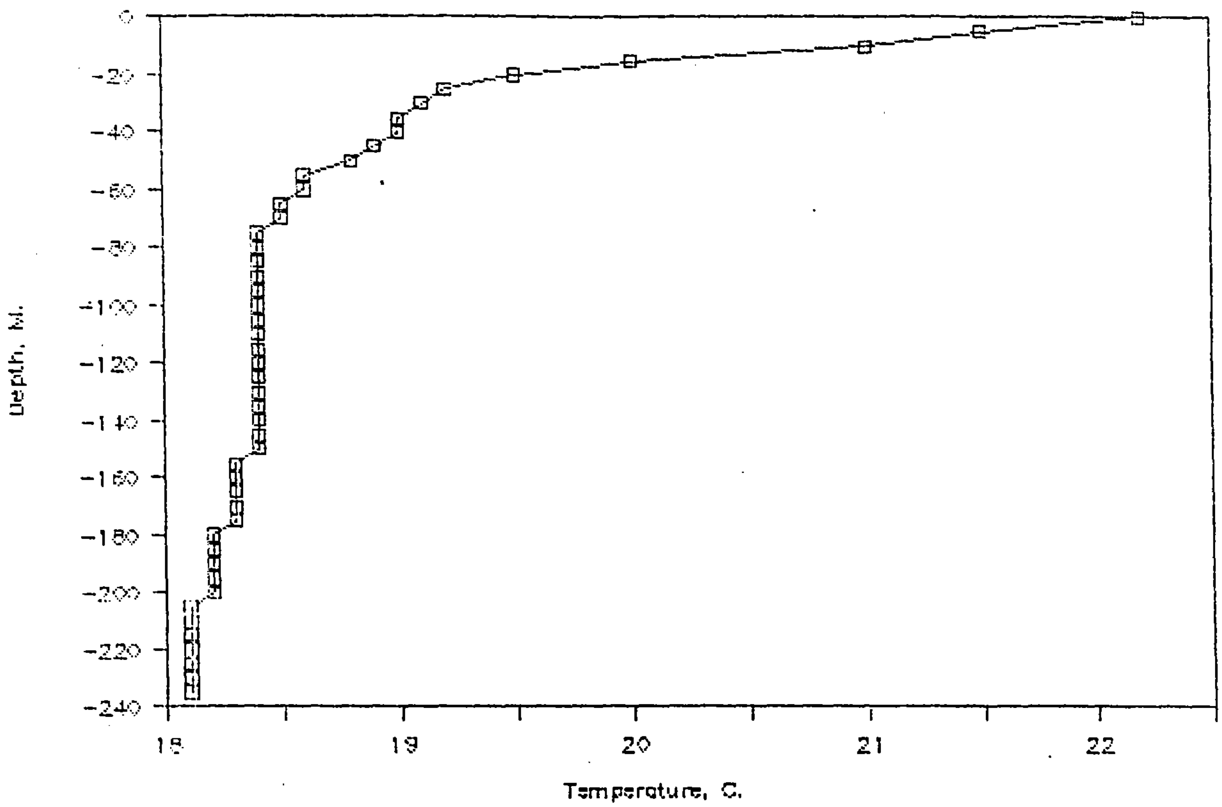
BT-038



BT-039

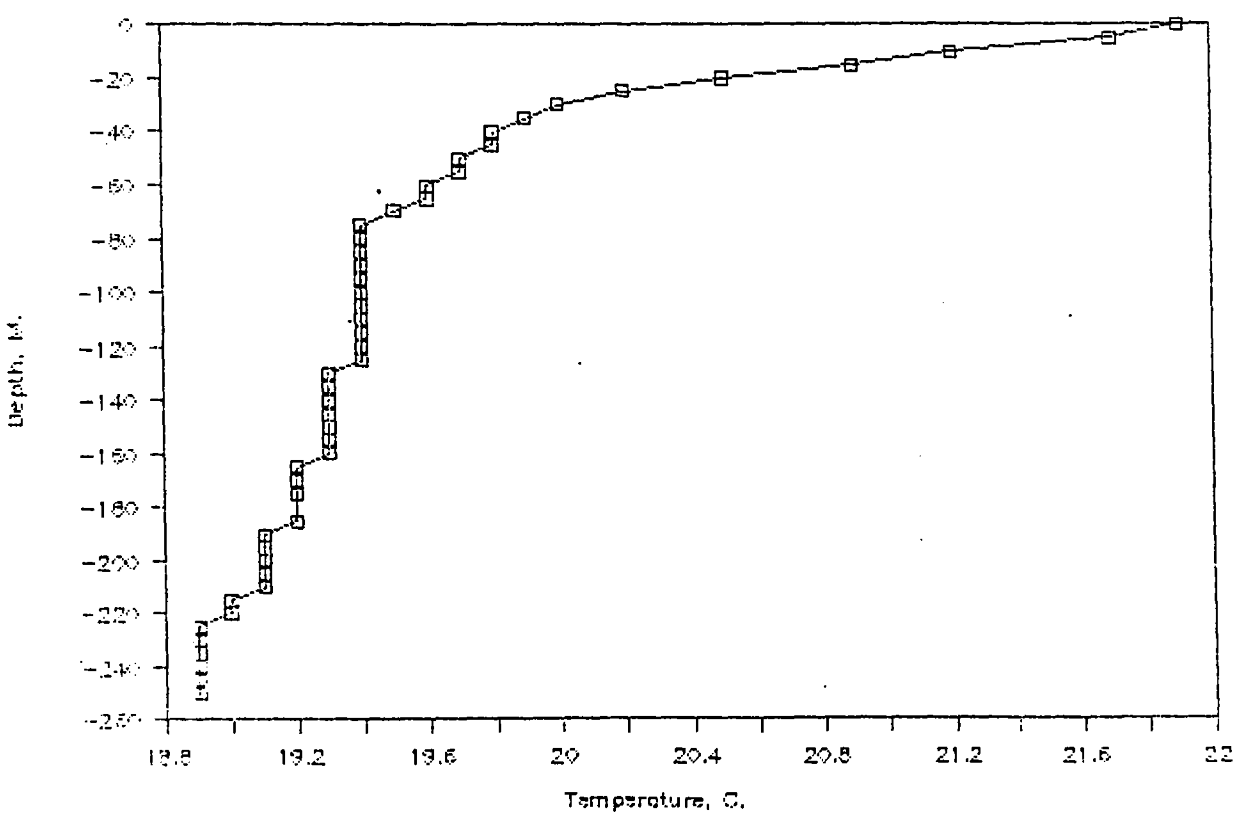


BT-040



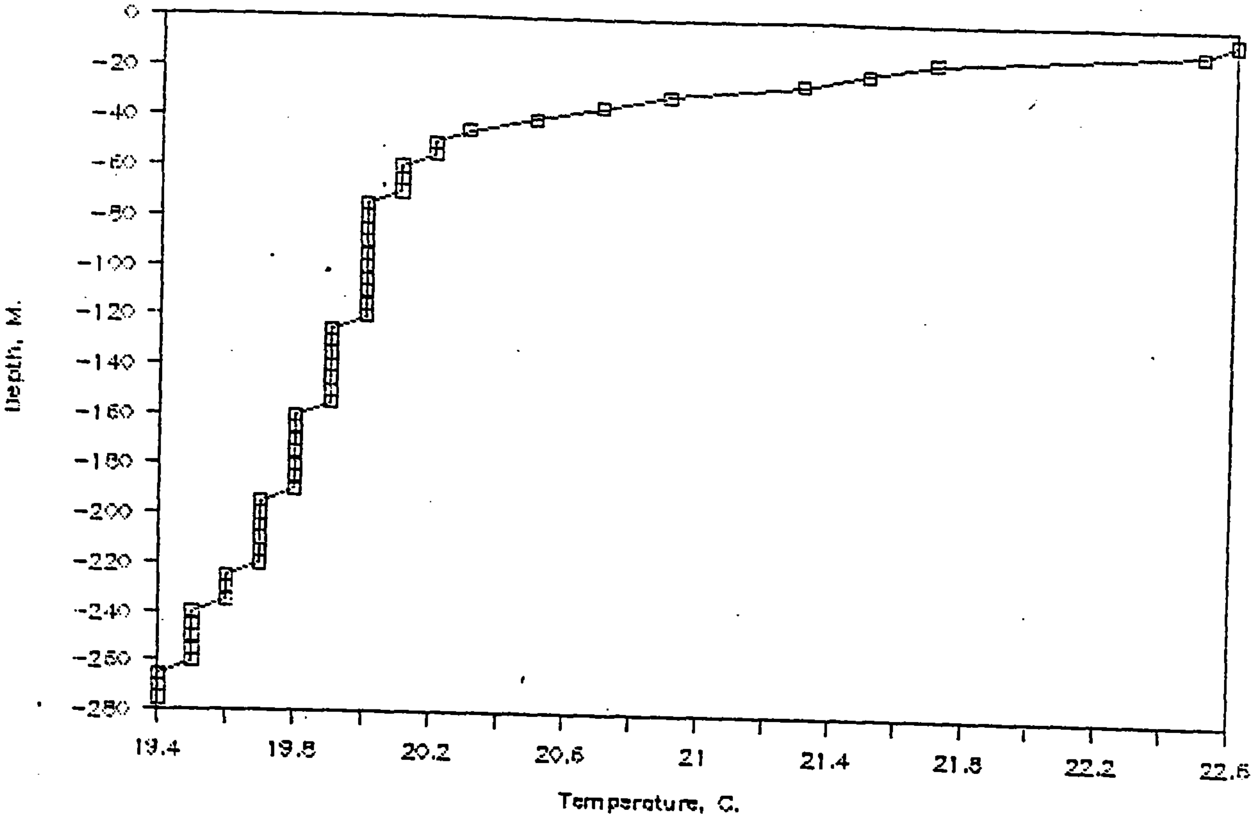
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
-240
Depth, M.
18
19
20
21
22
Temperature, C.

BT-041

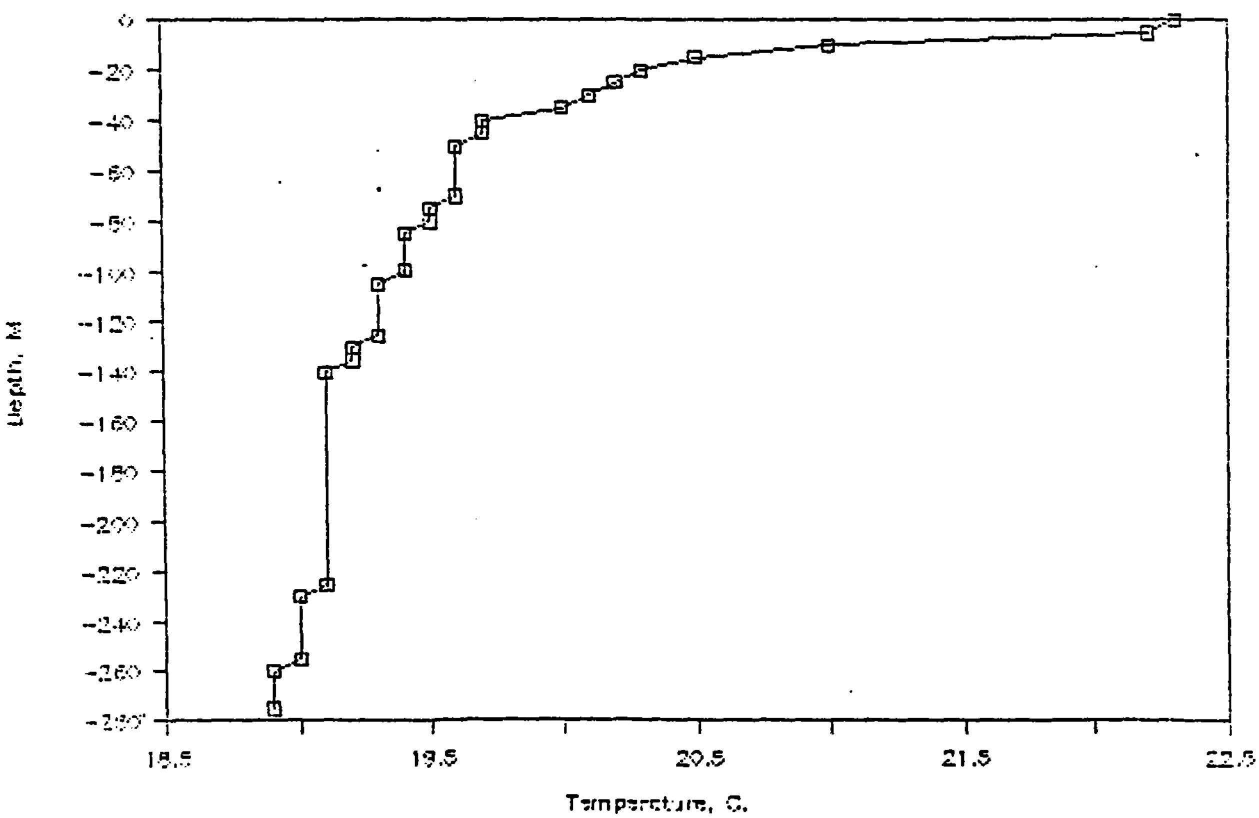


0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
-240
-260
Depth, M.
18.8
19.2
19.6
20
20.4
20.8
21.2
21.6
22
Temperature, C.

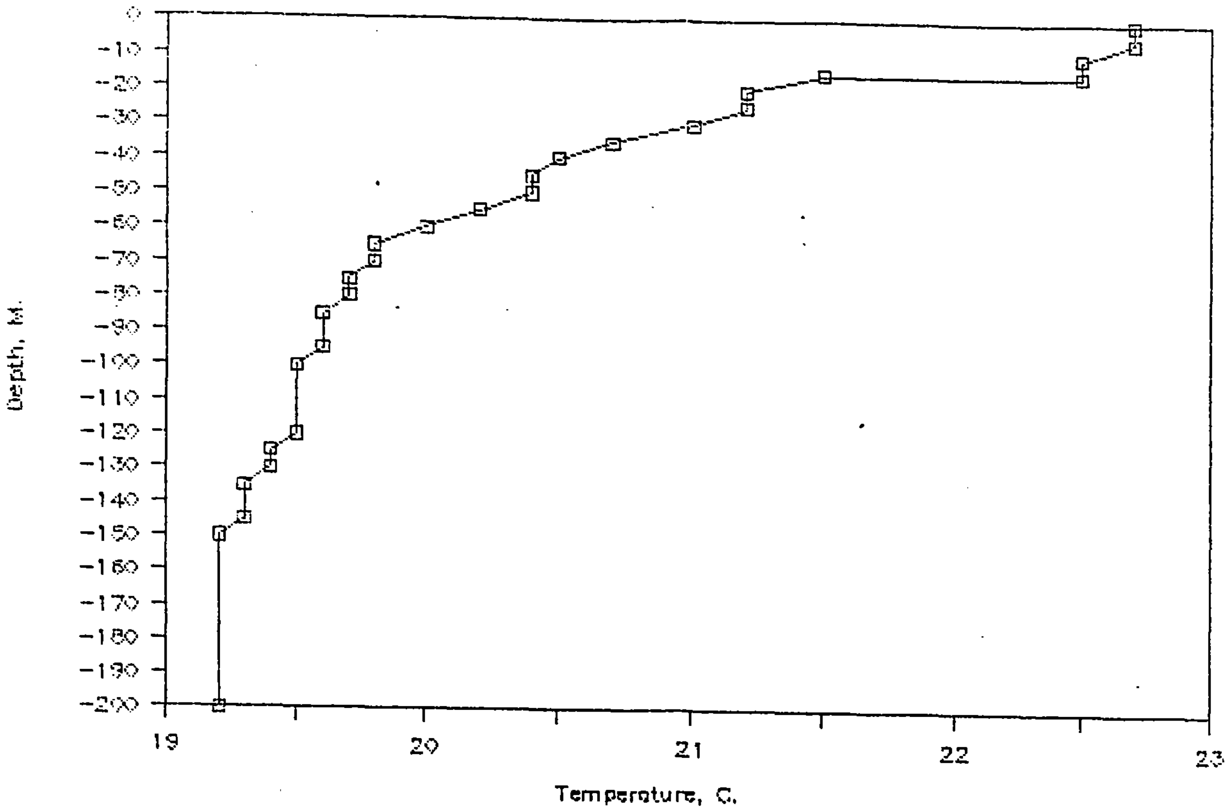
BT-042


Depth, M.
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
-240
-260
-280
19.4
19.8
20.2
20.6
21
21.4
21.8
22.2
22.6
Temperature, C.

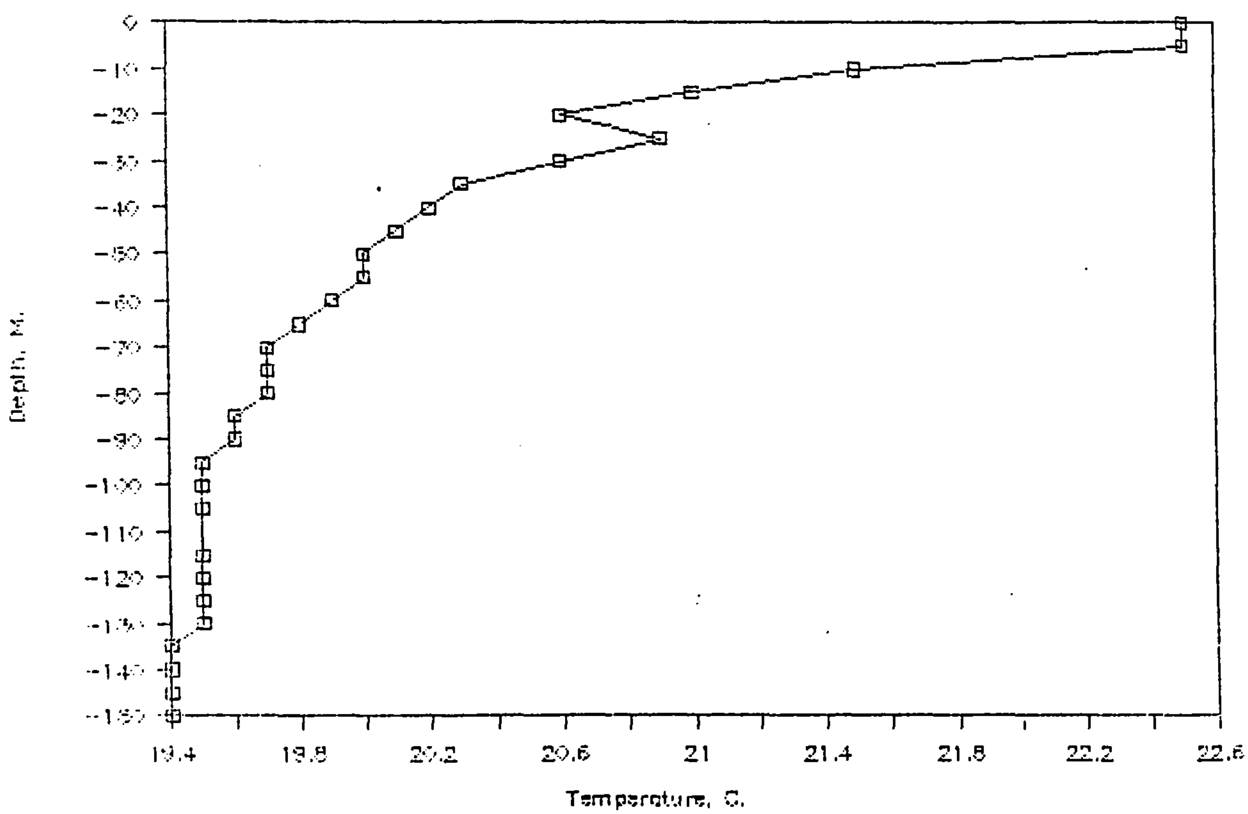
BT-043


Depth, M
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
-240
-260
-280
18.5
19.5
20.5
21.5
22.5
Temperature, C.

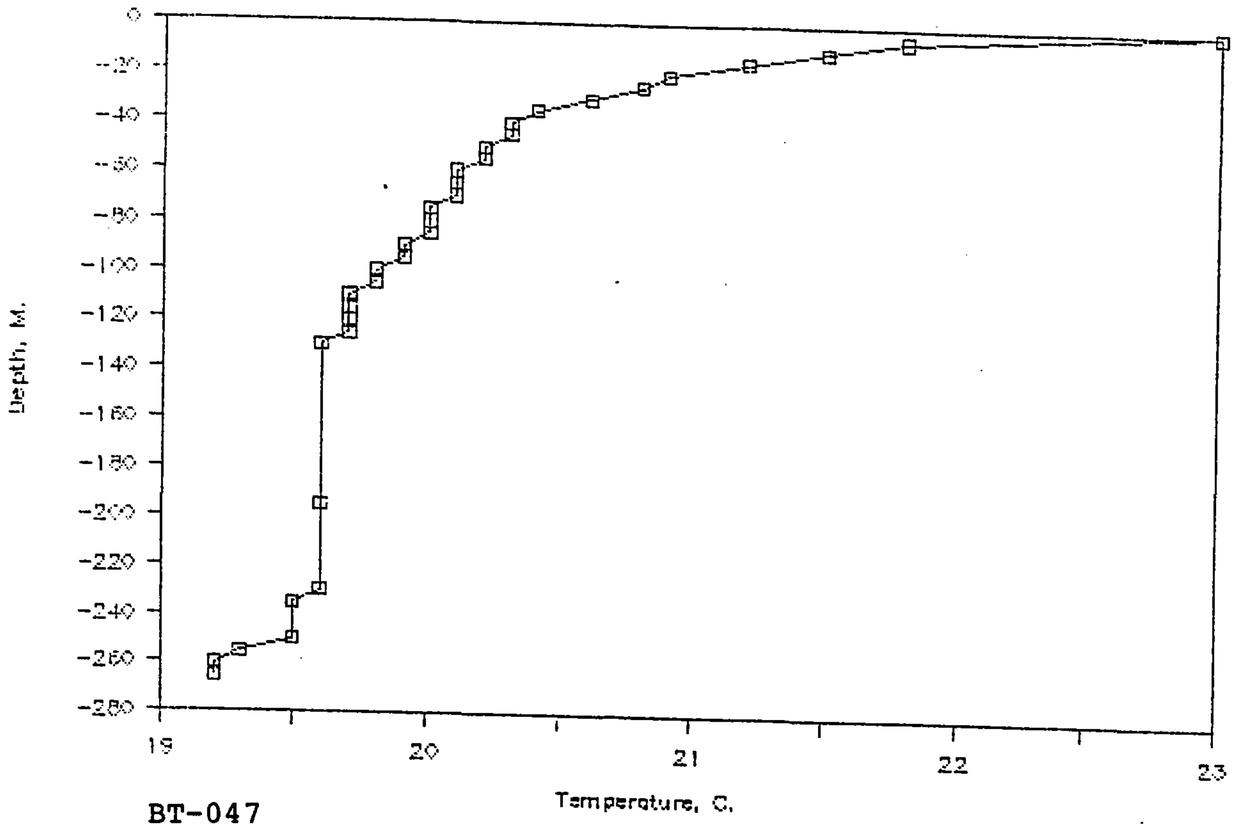
BT-044



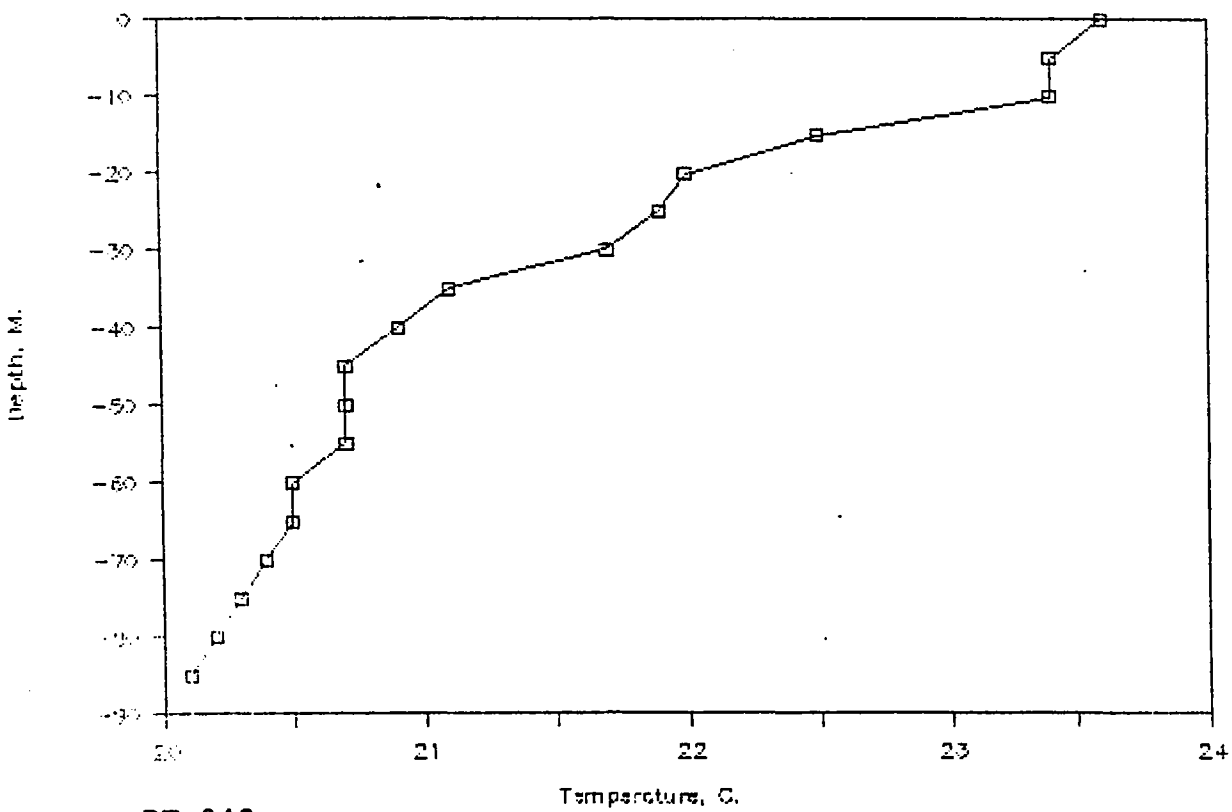
BT-045



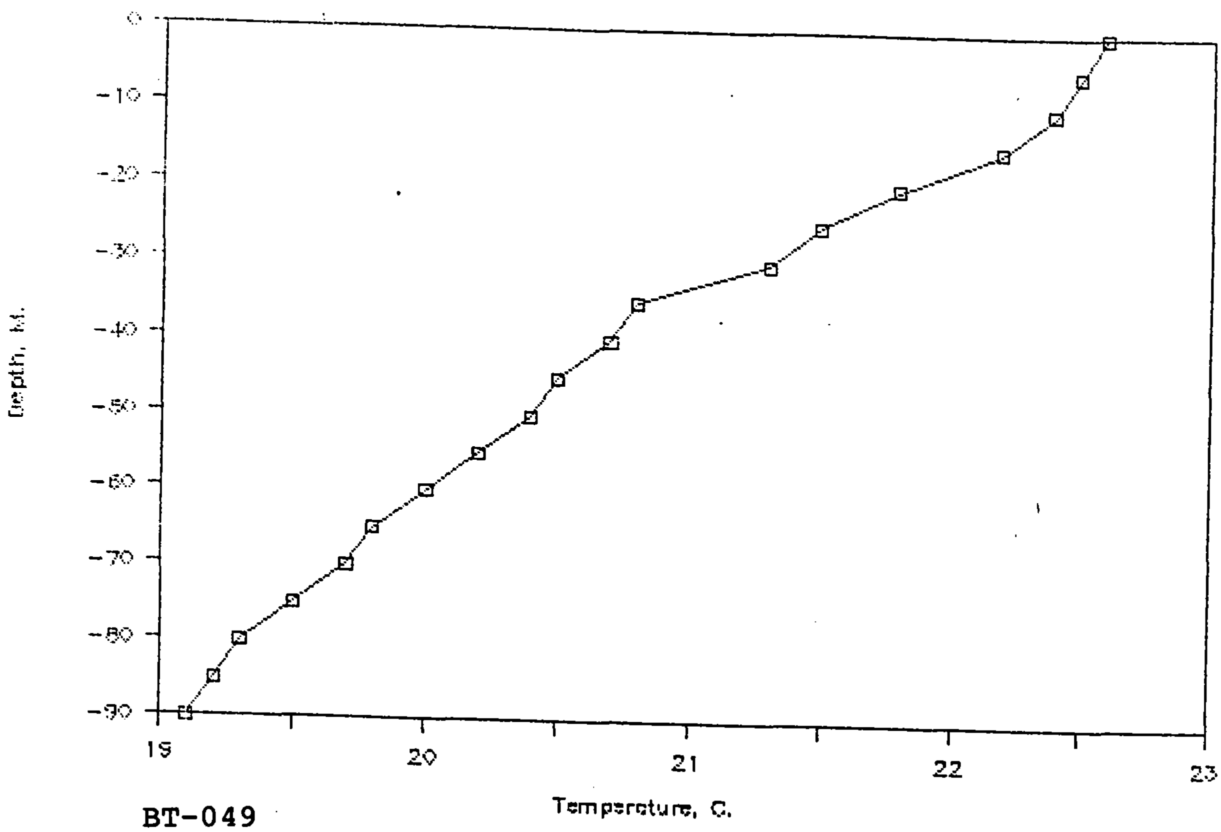
BT-046



BT-047

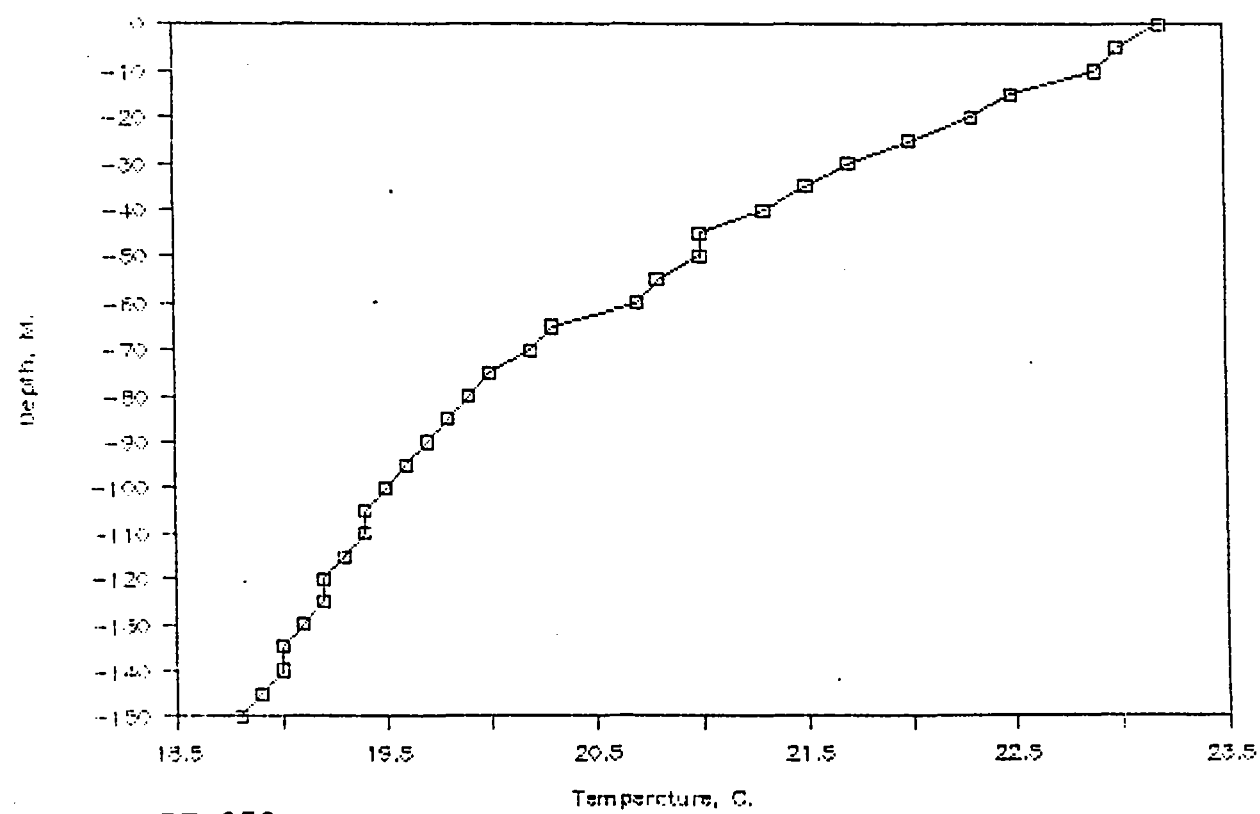


BT-048



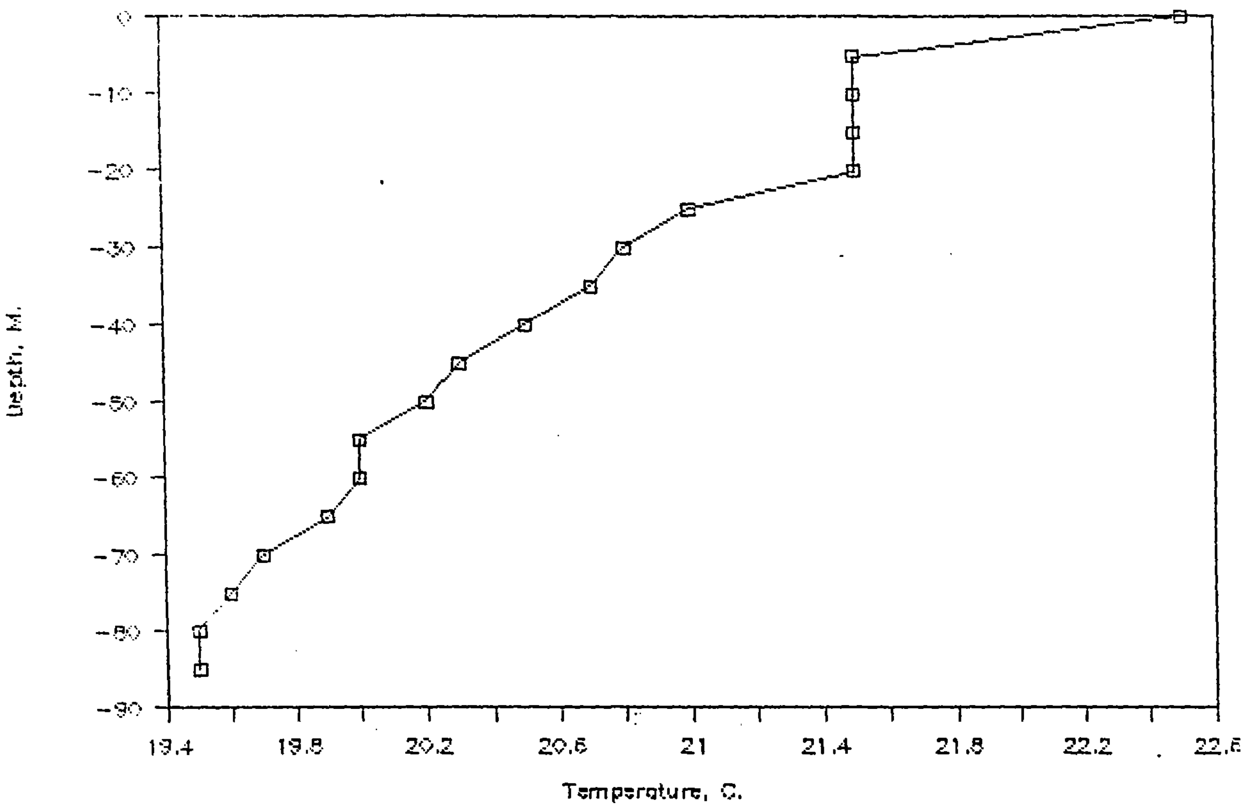
Depth, M.
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
19
20
21
22
23
Temperature, C.

BT-049

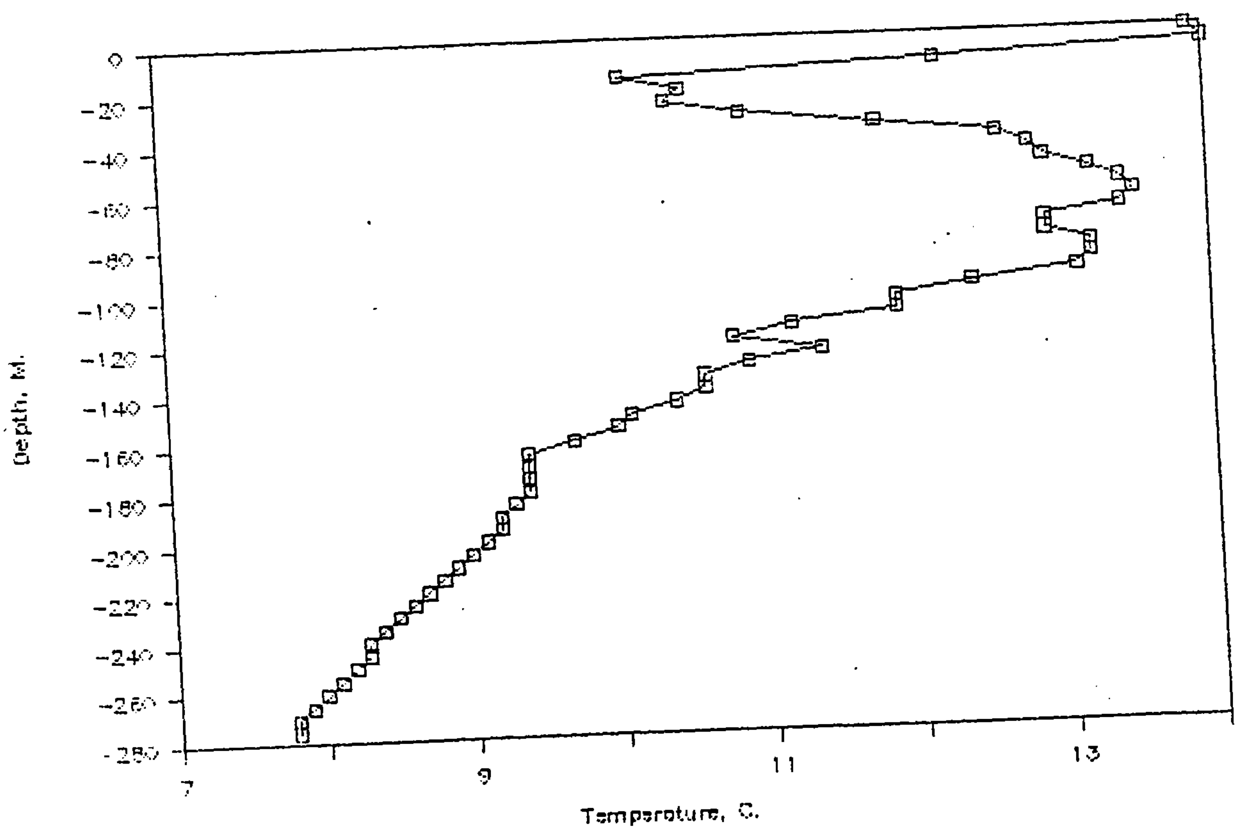


Depth, M.
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
18.5
19.5
20.5
21.5
22.5
23.5
Temperature, C.

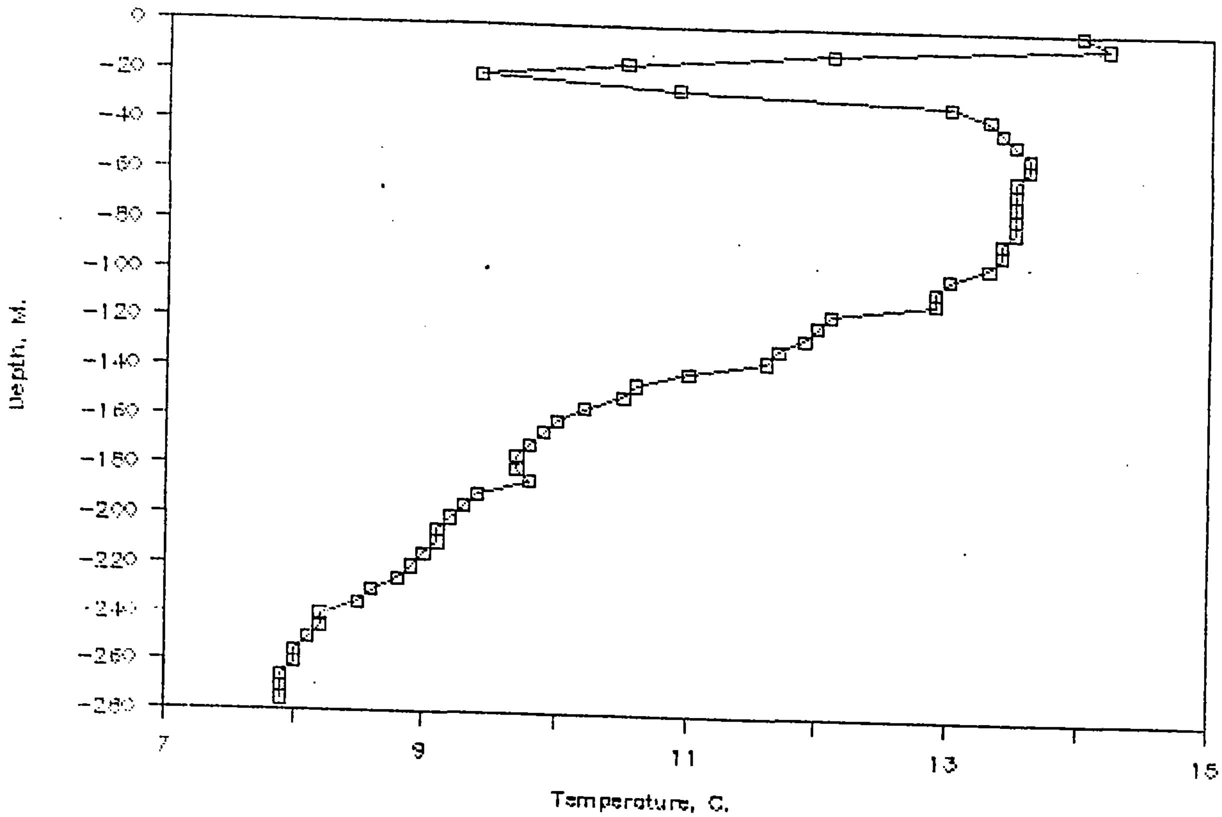
BT-050



BT-051

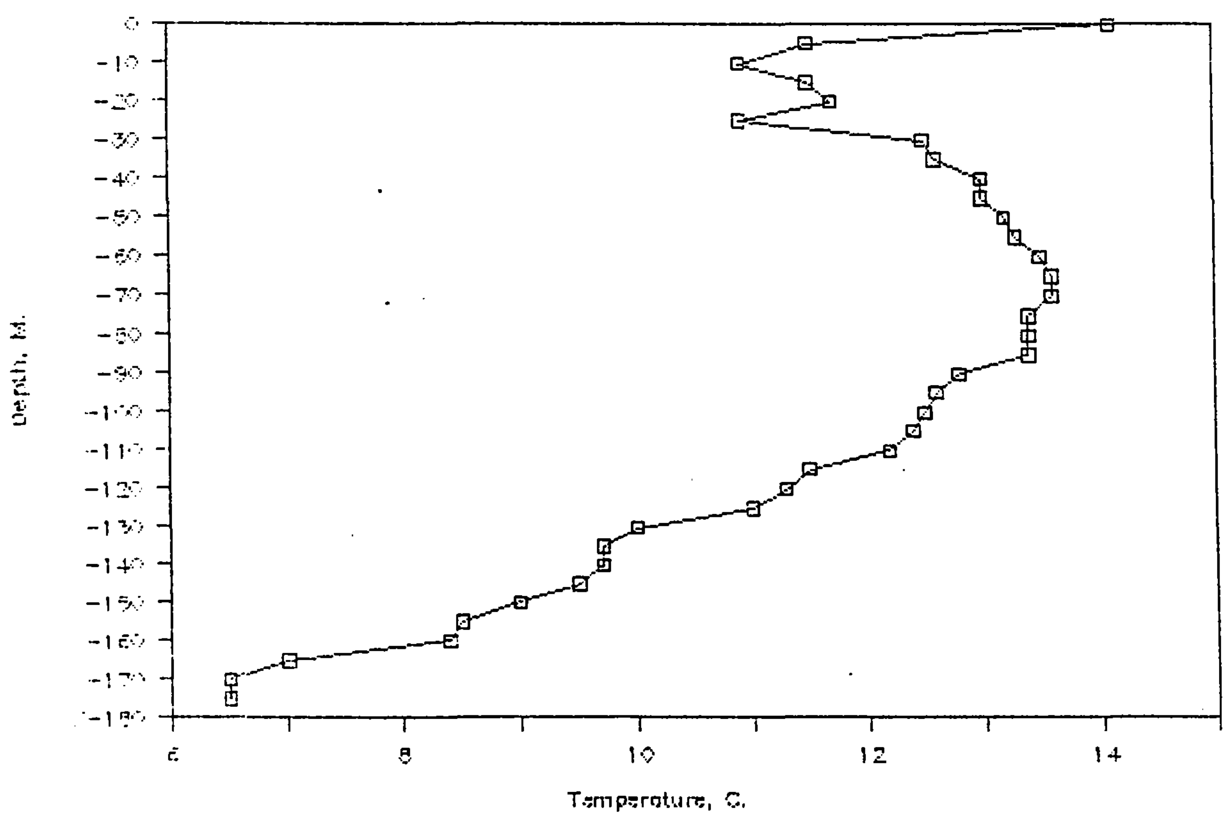


BT-052



Depth, M.
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
-240
-260
-280
7
9
11
13
15
Temperature, C.

BT-053



Depth, M.
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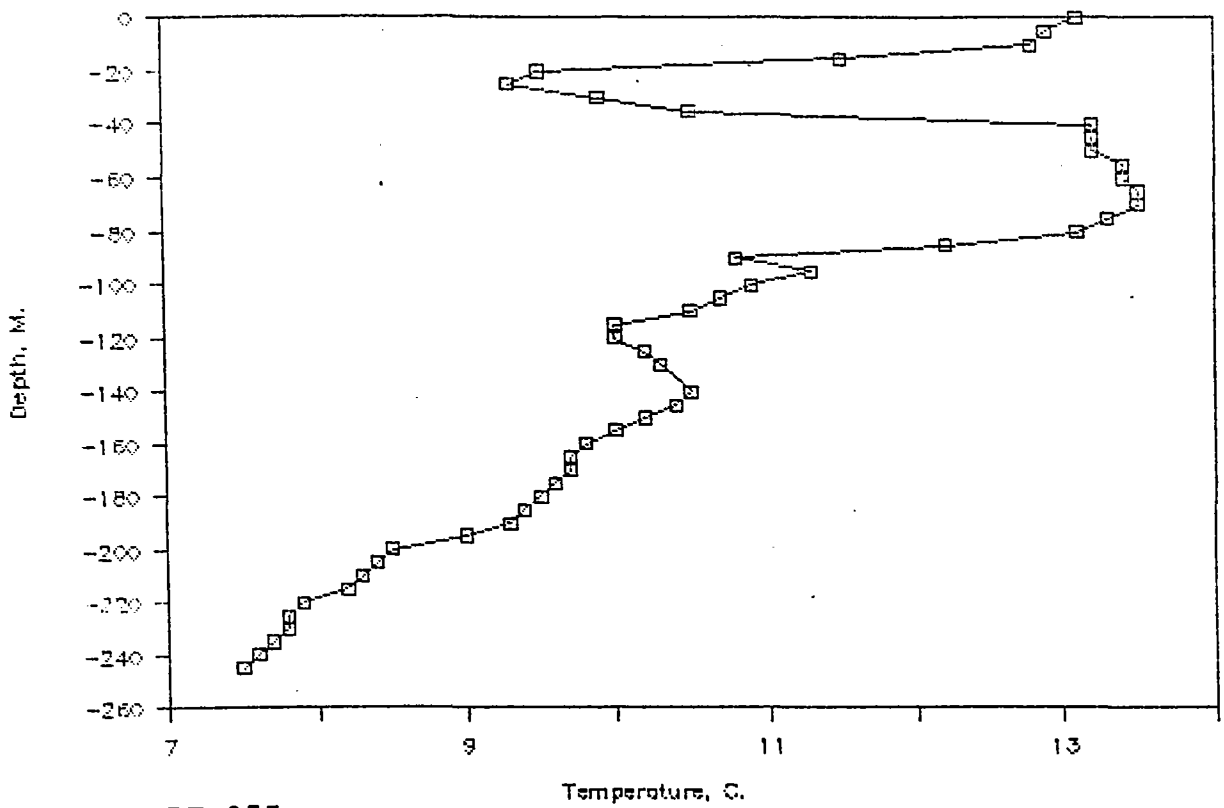
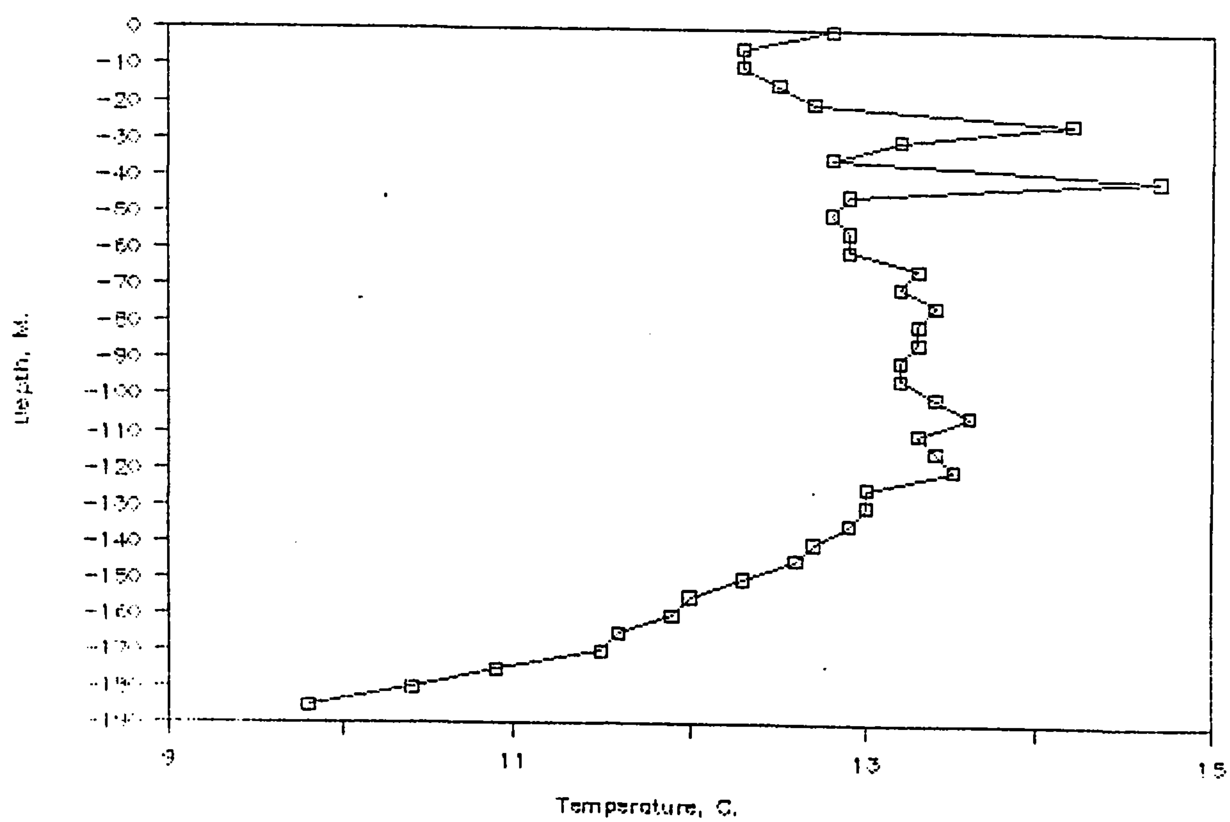
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
6
8
10
12
14
Temperature, C.

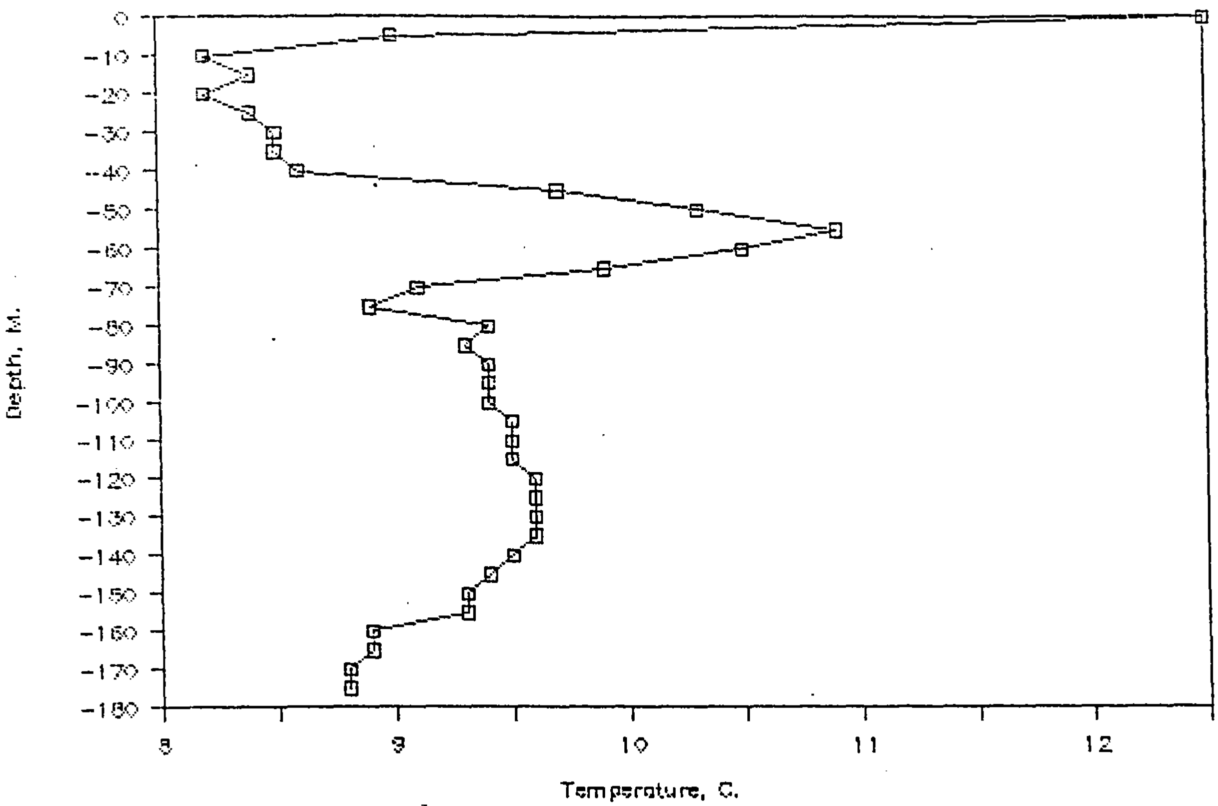
BT-054



BT-055

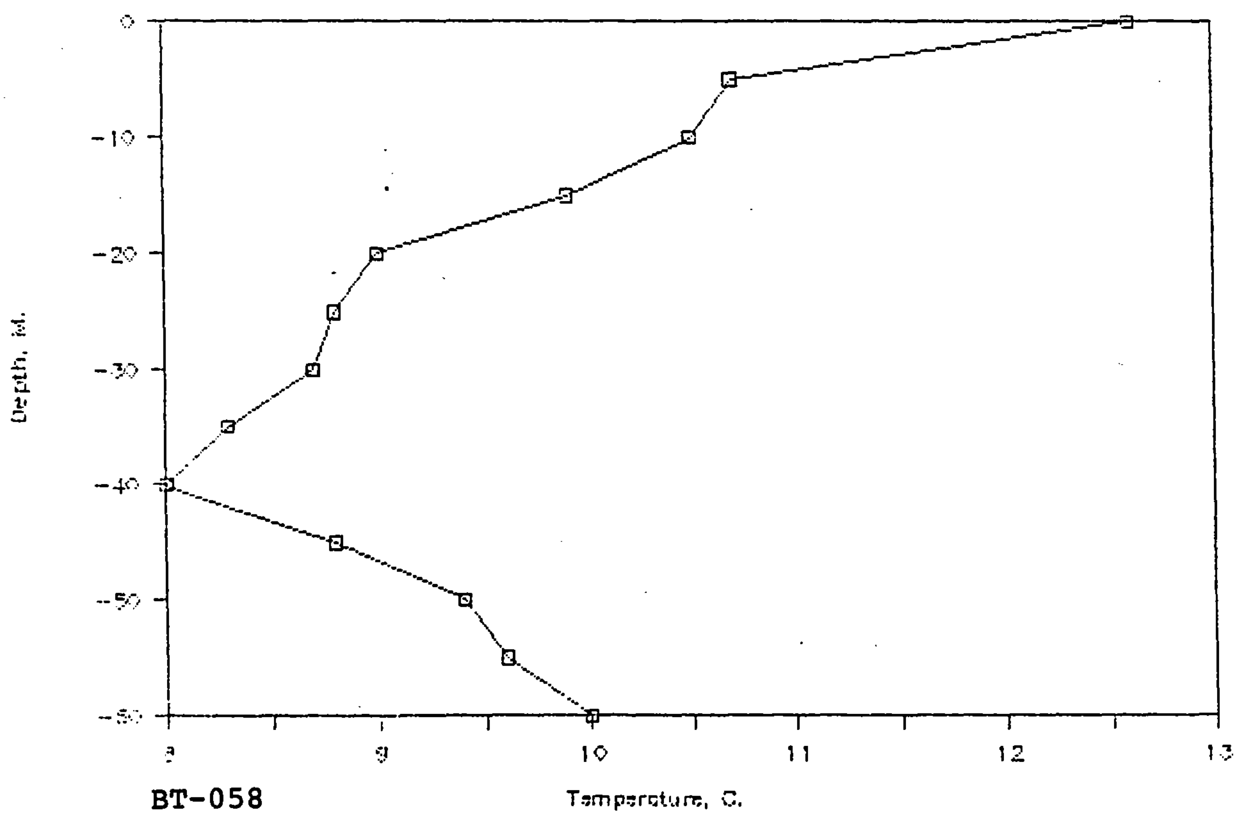


BT-056



Depth, M.
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
8
9
10
11
12
Temperature, C.

BT-057



Depth, M.
0
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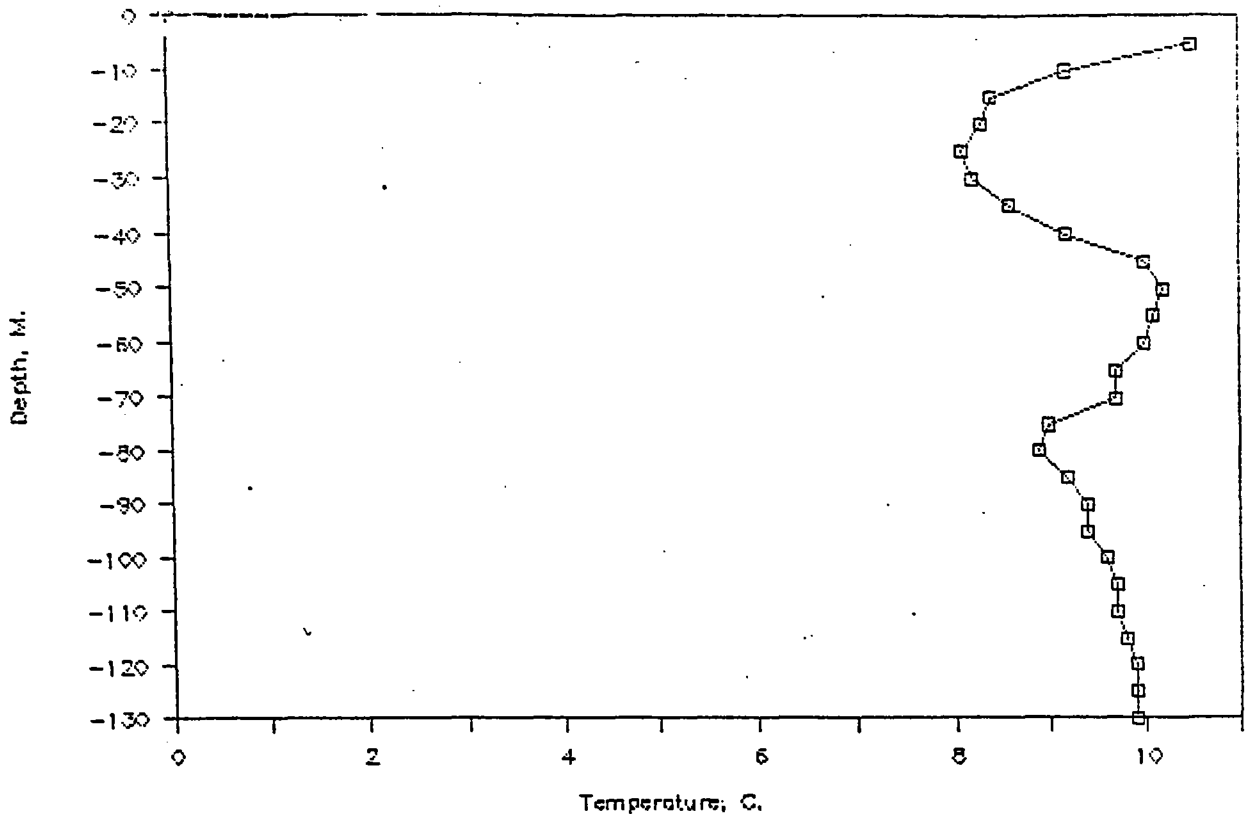
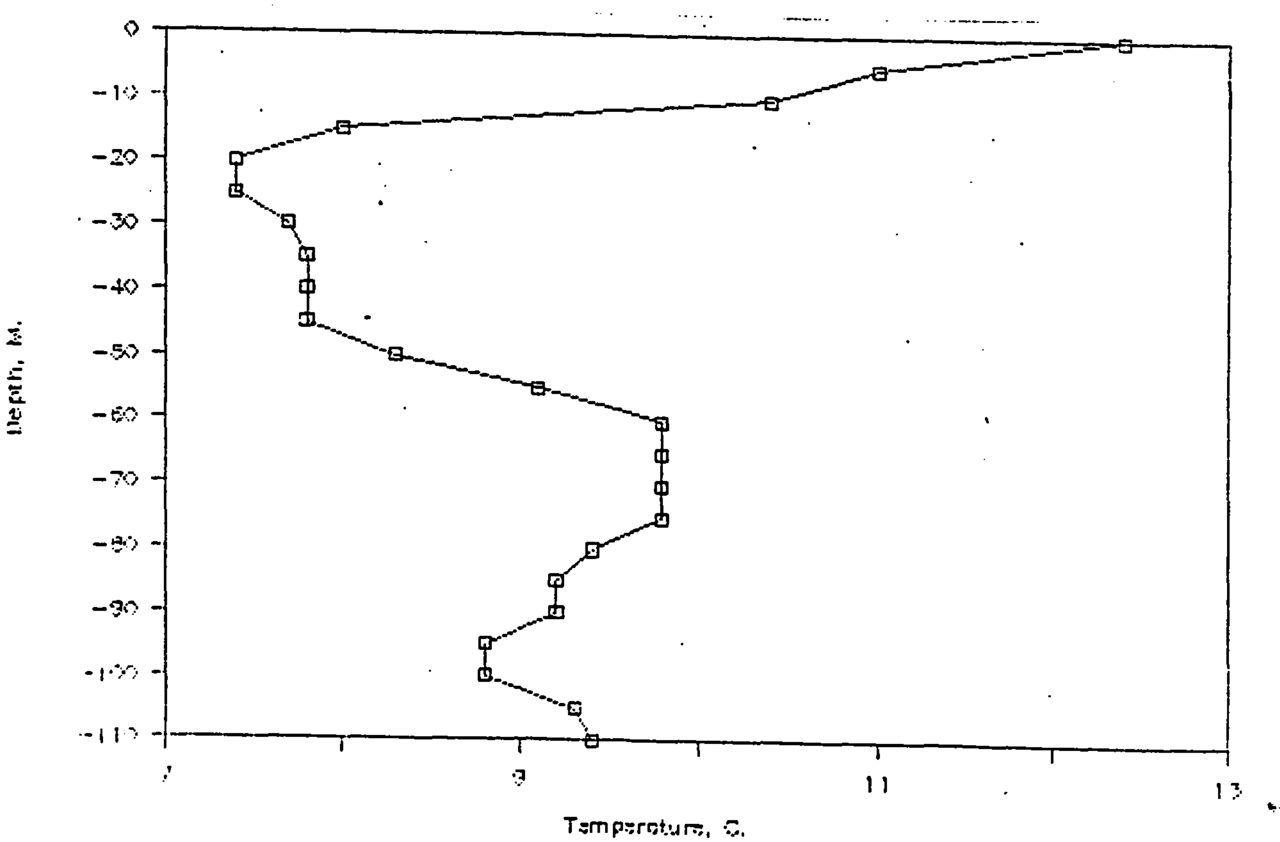
-20
-30
-40
-50
-60
8
9
10
11
12
13
Temperature, C.

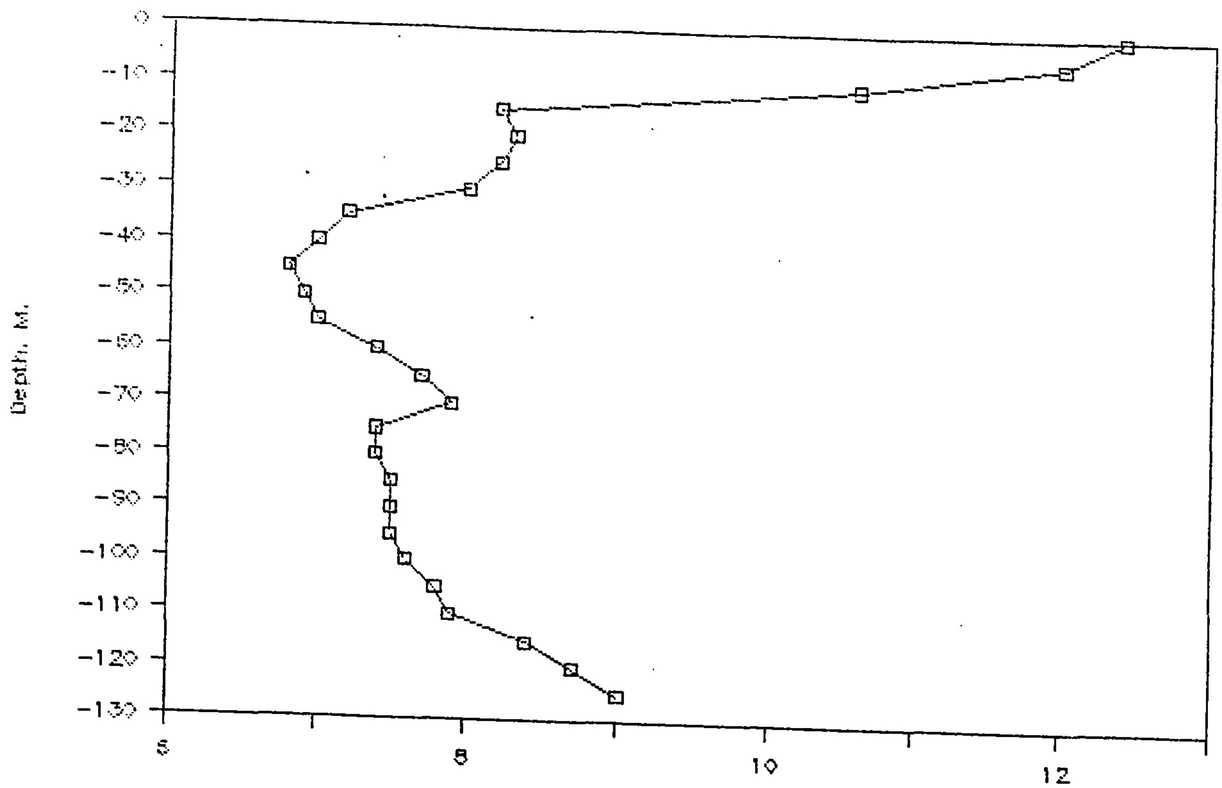
BT-058



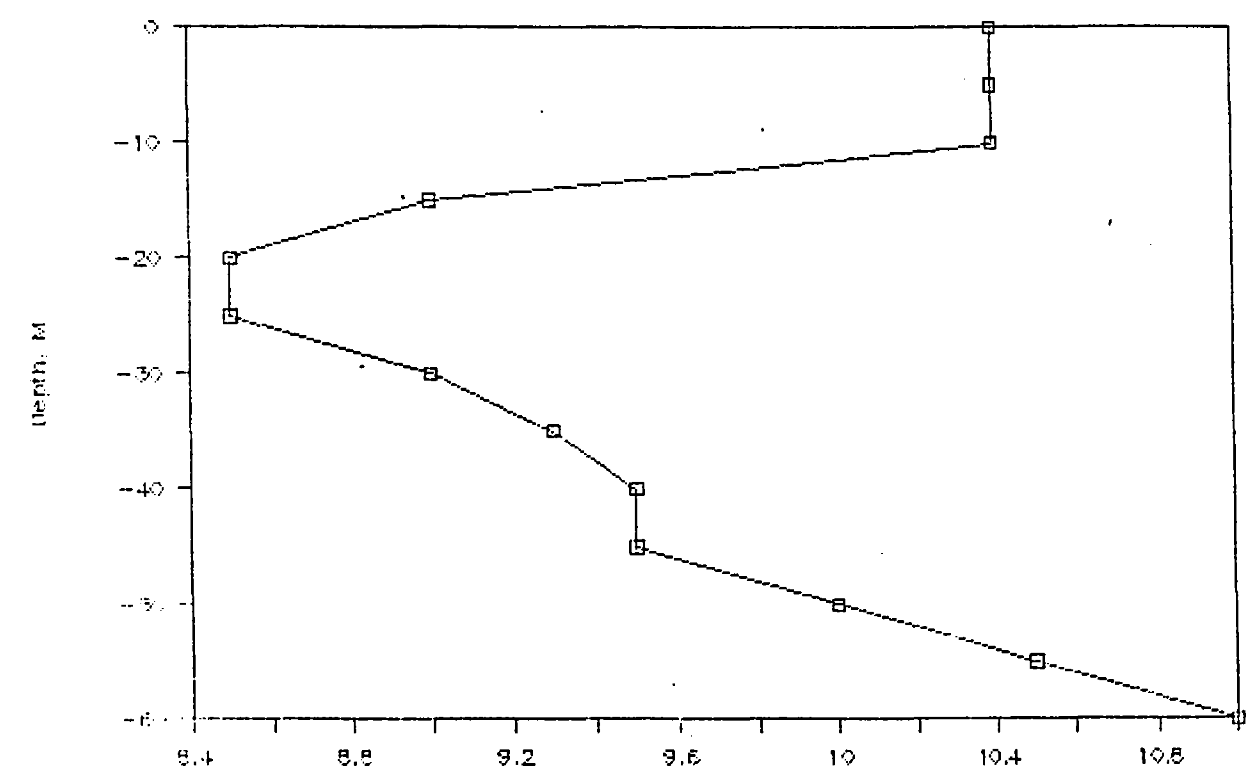
BT-059



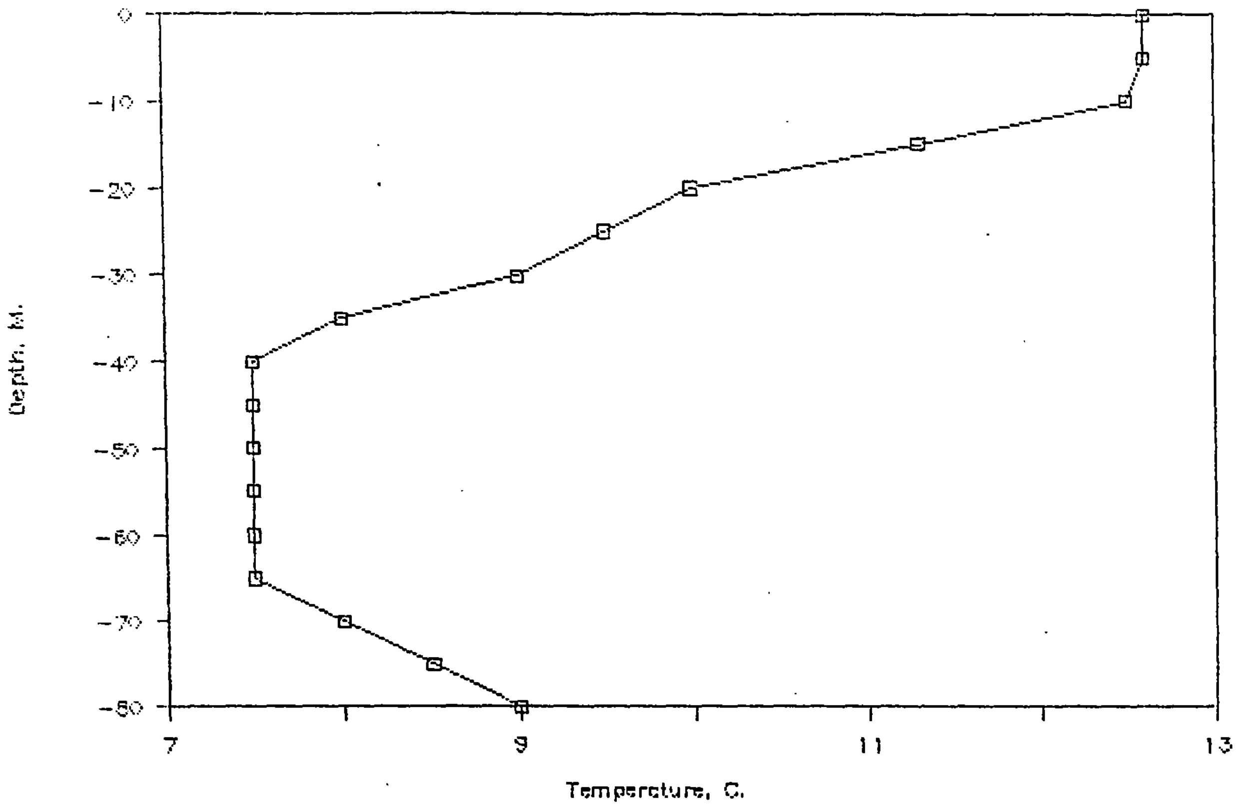
BT-060



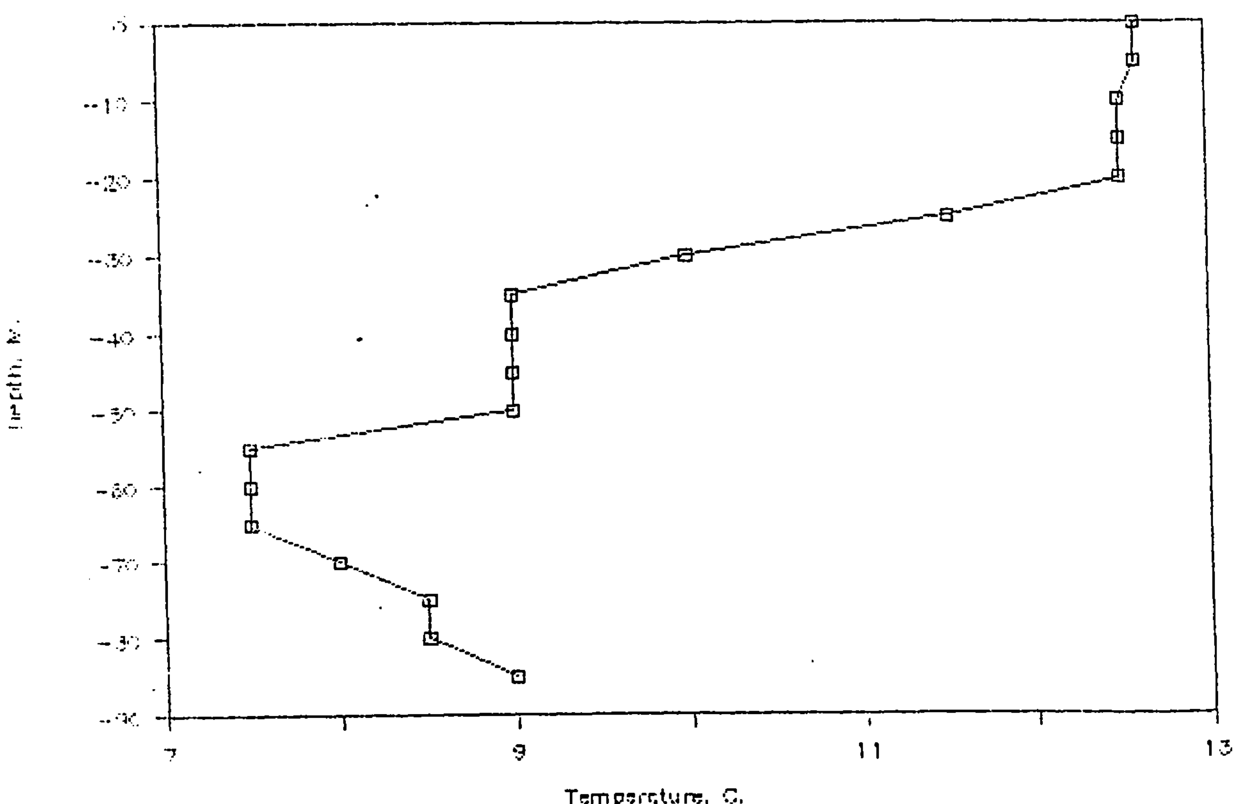
BT-061



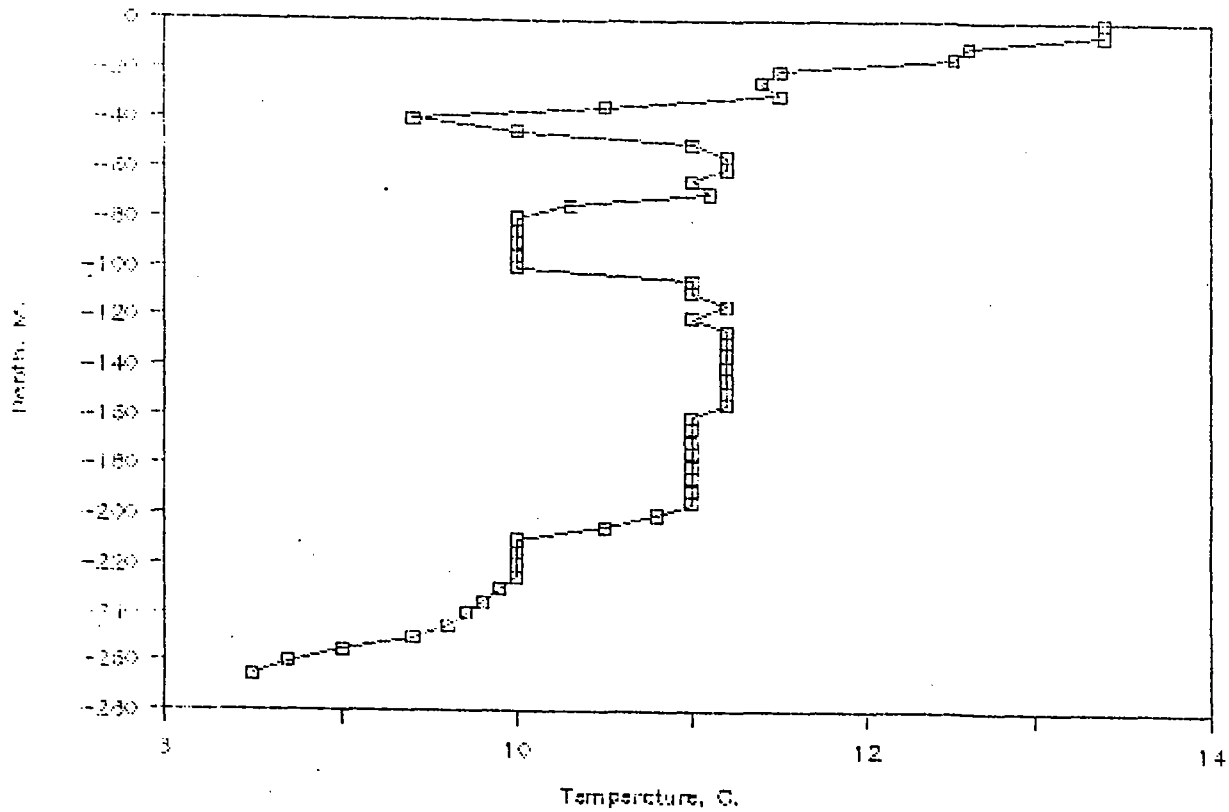
BT-063


0
-10
-20
-30
-40
-50
-60
-70
-80
Depth, M.
7
9
11
13
Temperature, C.

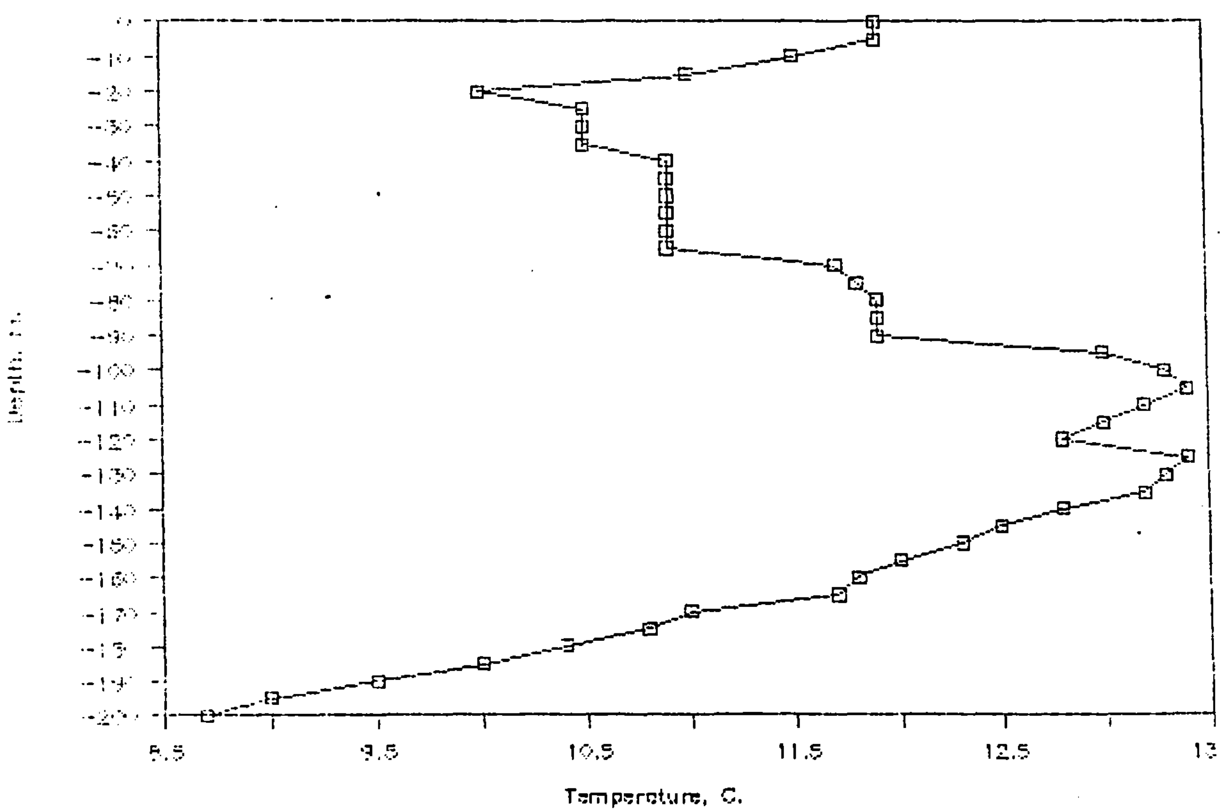
BT-064


-10
-20
-30
-40
-50
-60
-70
-80
Depth, M.
7
9
11
13
Temperature, C.

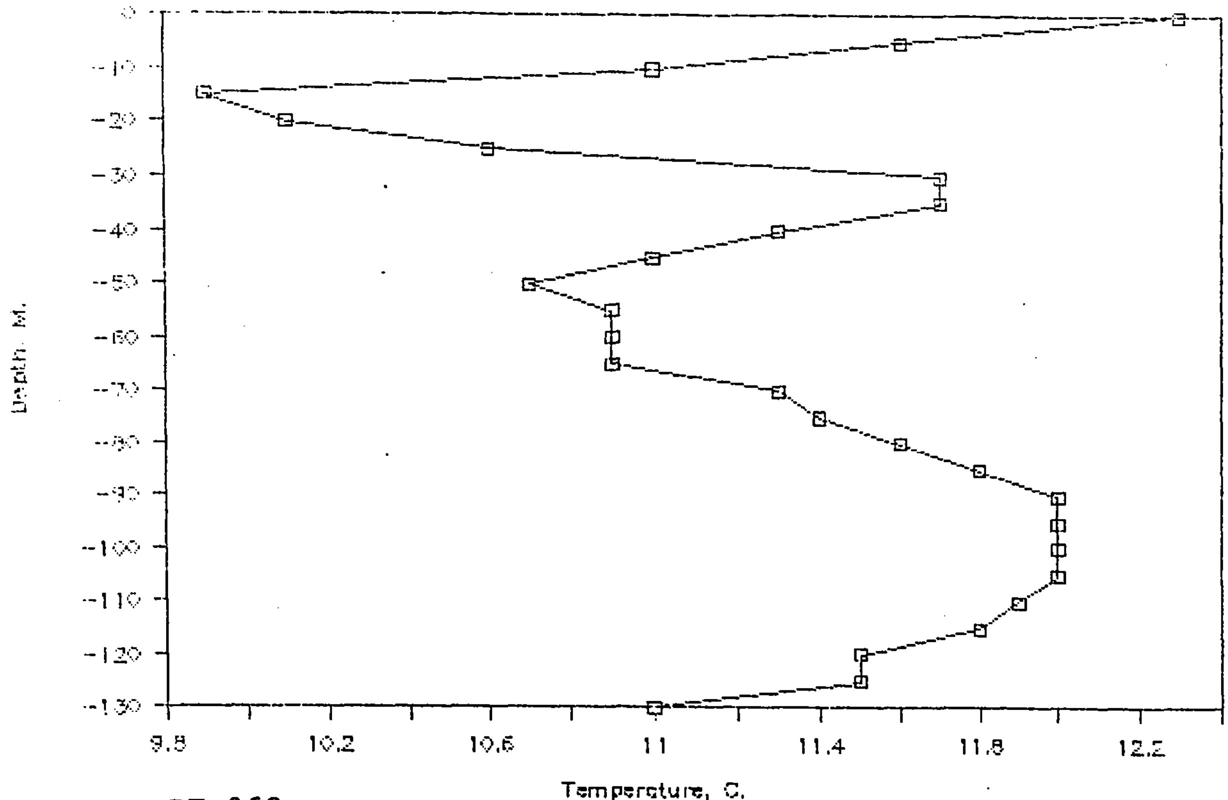
BT-065



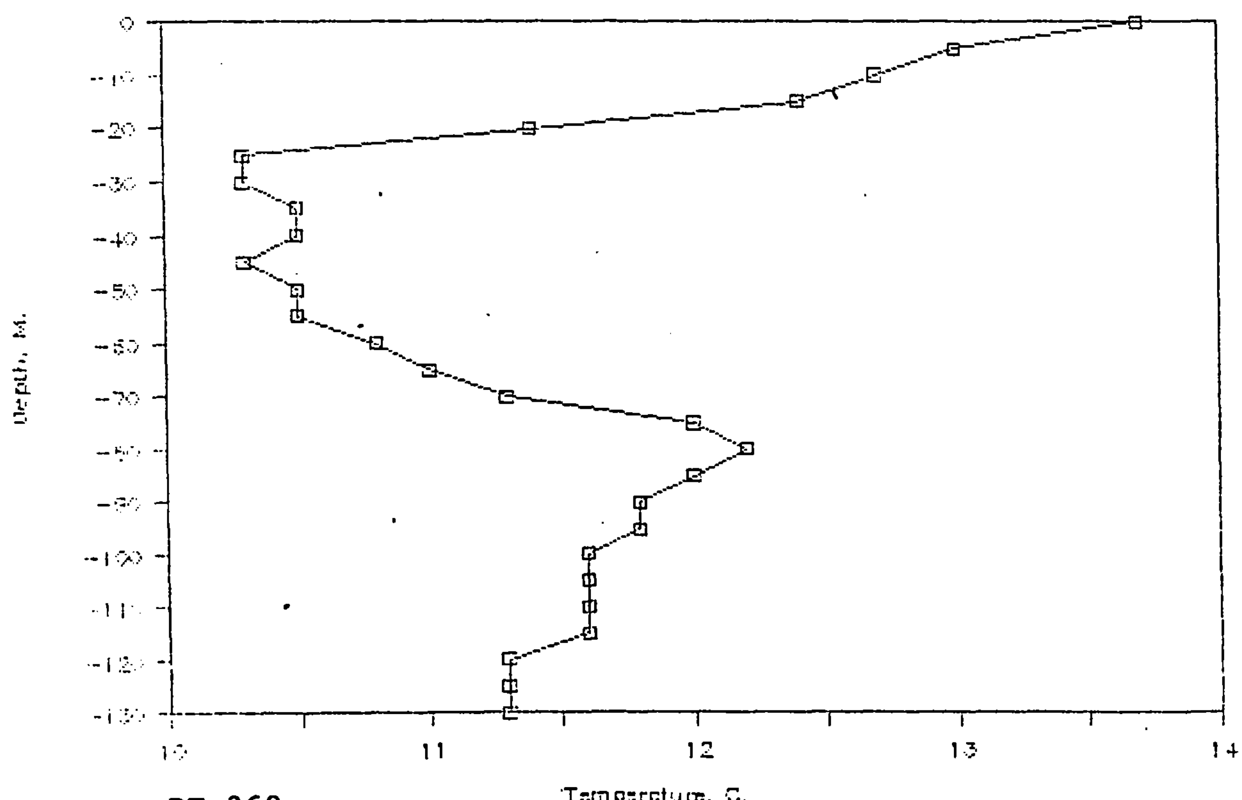
BT-066



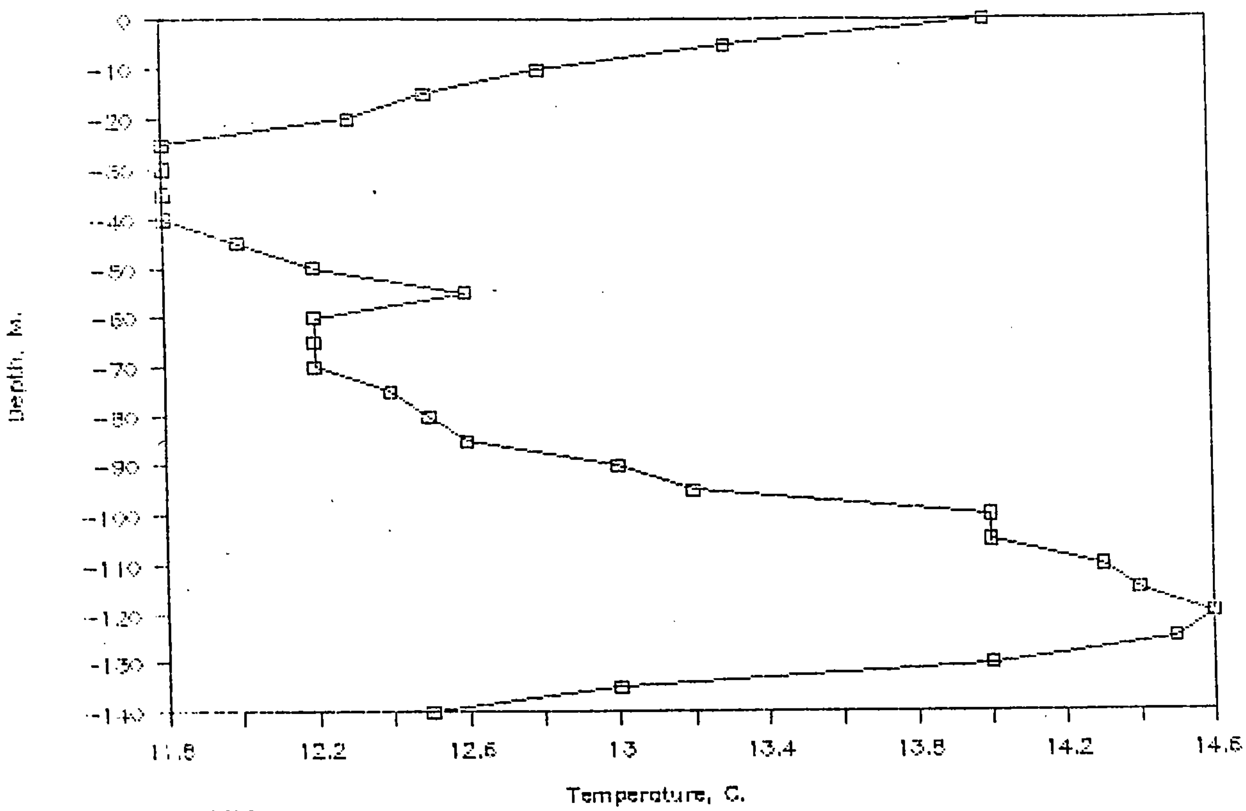
BT-067



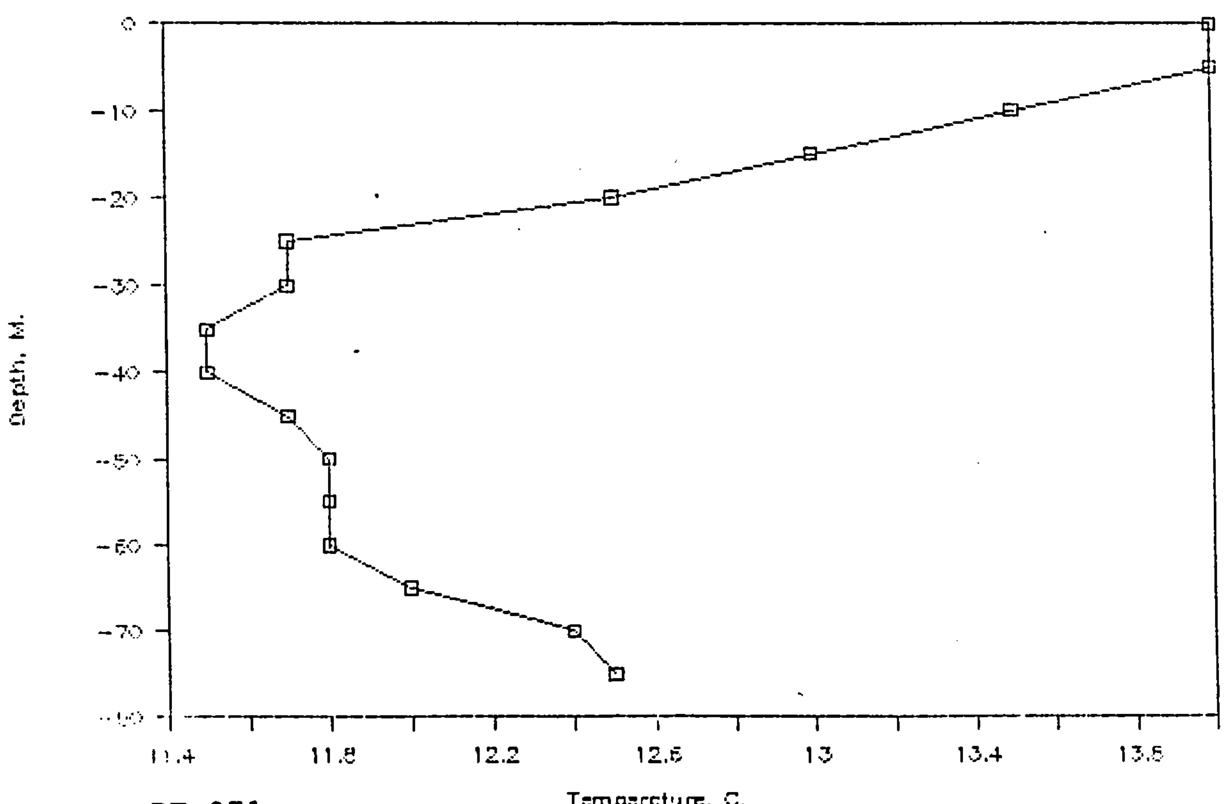
BT-068



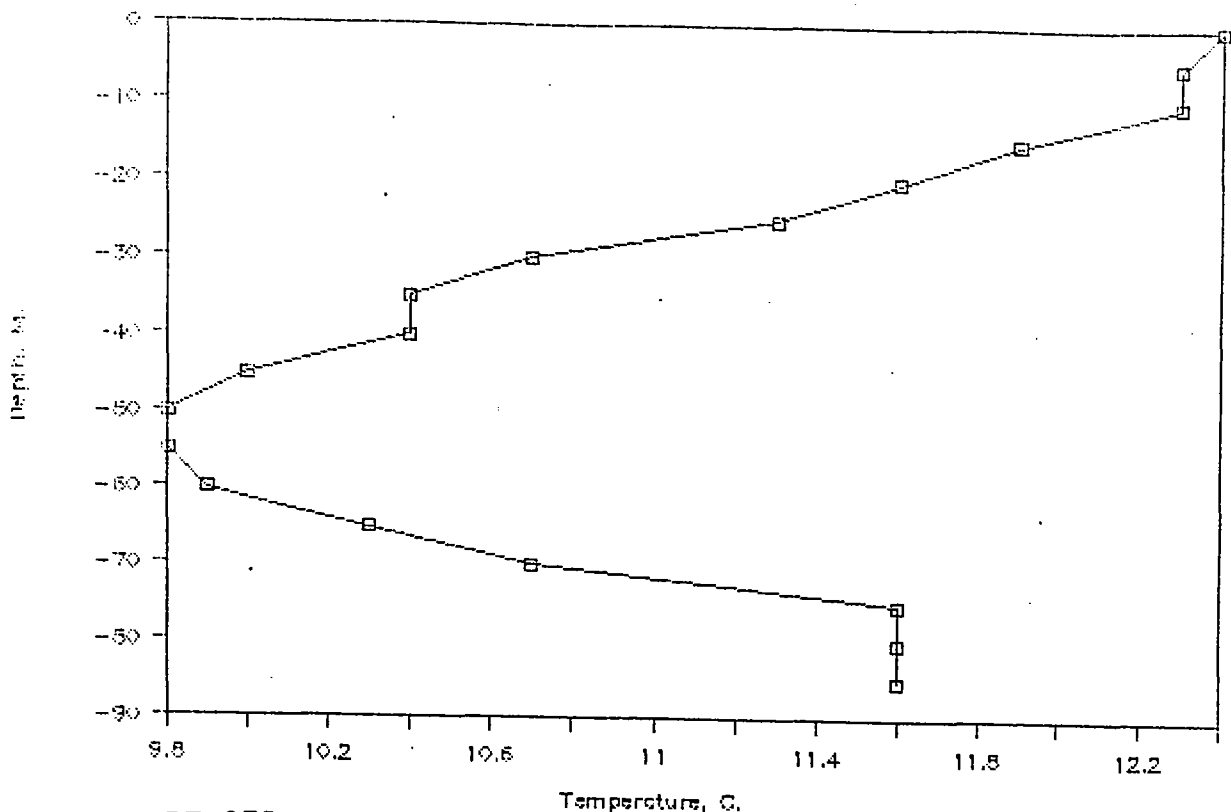
BT-069


0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
Depth, M.
11.8
12.2
12.6
13
13.4
13.8
14.2
14.6
Temperature, C.

BT-070

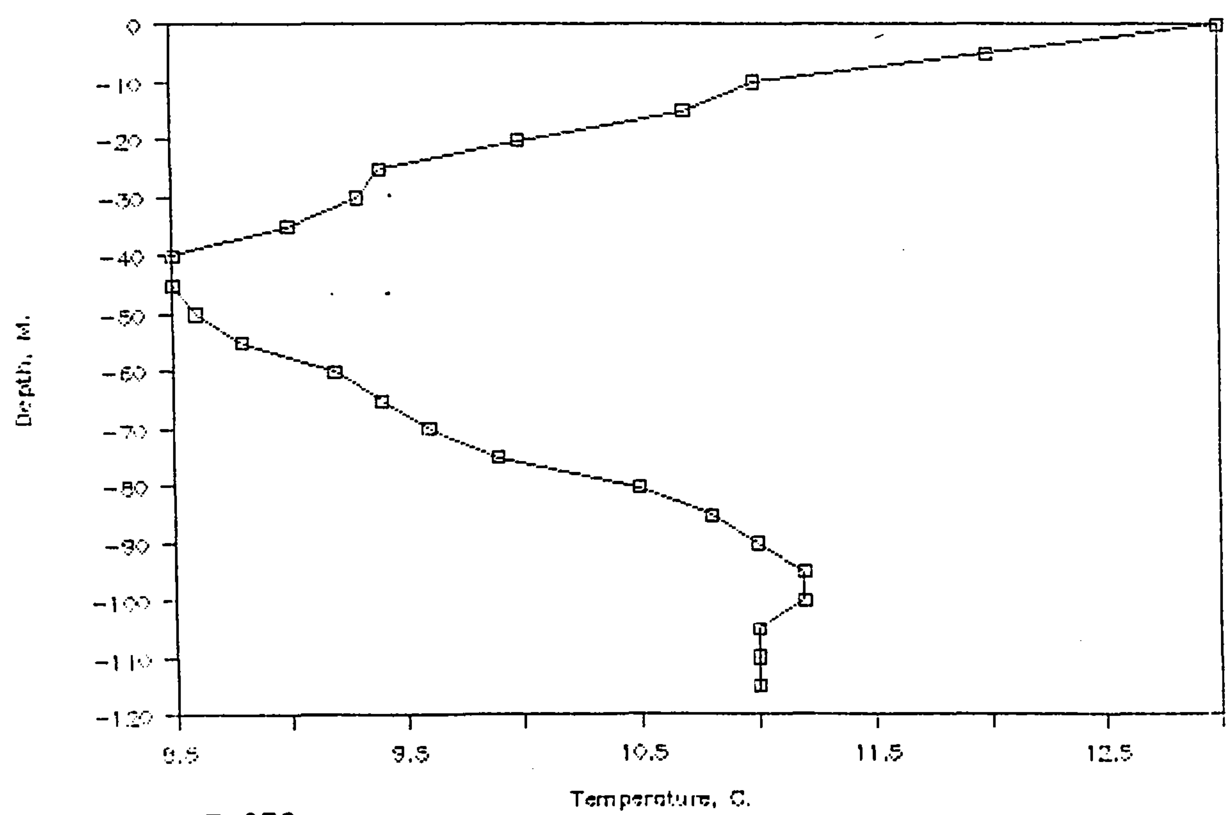

0
-10
-20
-30
-40
-50
-60
-70
-80
Depth, M.
11.4
11.8
12.2
12.6
13
13.4
13.8
Temperature, C.

BT-071



0
-10
-20
-30
-40
-50
-60
-70
-80
-90
Depth, M.
9.8
10.2
10.6
11
11.4
11.8
12.2
Temperature, C.

BT-072



0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
Depth, M.
8.5
9.5
10.5
11.5
12.5
Temperature, C.

BT-073

APPENDIX 6. Surface station listing.

STATION	DATE	TIME	LOG	LAT	LONG	SALIN	SURFT	PO4	CHLORO
SS-0001	25-May-89	1130	111.1	40.23	69.72	32.814	12.90	0.05	0.00
SS-0002	25-May-89	1648	134.7	40.06	69.43	32.633	12.40	0.04	0.25
SS-0003	25-May-89	1730	138.5	40.02	69.37	32.676	12.70	0.03	
SS-0004	25-May-89	1823	142.3	39.98	69.30	32.567	12.80		
SS-0005	25-May-89	1918	146.3	39.95	69.25	32.779	12.90	0.04	0.23
SS-0006	25-May-89	2002	150.3	39.90	69.18	32.836	13.30	0.04	
SS-0007	25-May-89	2045	154.3	39.87	69.12	31.563	13.30		0.29
SS-0008	25-May-89	2130	158.3	39.83	69.06	33.088	13.70	0.05	0.39
SS-0009	25-May-89	2203	161.5	39.77	68.97	31.406	13.80		0.49
SS-0010	26-May-89	0838	181.5	39.42	68.52	33.191	13.60	0.05	0.04
SS-0011	26-May-89	1500	206.2	39.18	68.73	32.234	15.70		
SS-0012	26-May-89	1745	221.2	39.03	68.98	30.725	14.10		
SS-0013	26-May-89	2130	240.5	38.88	69.03	33.162	19.70		
SS-0014	27-May-89	0135	265.1	38.85	68.63	34.927	18.90		
SS-0015	27-May-89	0330	276.9	38.75	68.30	33.564	21.00	0.03	0.03
SS-0016	27-May-89	0645	297.4	38.62	67.93	33.642	16.40		0.29
SS-0017	27-May-89	1030	317.4	38.68	68.23	33.100	20.60	0.02	0.23
SS-0018	27-May-89	1535	337.4	38.45	67.95	33.560	18.90		
SS-0019	27-May-89	2320	373.6	38.25	67.22	35.347	24.00	0.02	
SS-0020	28-May-89	0721	431.1	37.57	67.55	34.068	19.10		
SS-0021	28-May-89	1001	445.0	37.37	67.70	34.258	19.10		0.23
SS-0022	28-May-89	1400	467.7	37.03	67.60	34.090	18.90	0.03	
SS-0023	28-May-89	2100	524.1	36.38	67.25	36.053	23.70	0.04	0.02
SS-0024	29-May-89	1745	622.8	34.88	66.45	36.408	22.60	0.02	

APPENDIX 7. OUR SONGS

A FEW GOOD MEN
Chum

She's a woman's ship
And she's run right fine
And we'll make our way
O'er the salty brine,
But there's one more thing
That we need on board
'Fore we weigh our anchor
And leave this port:

We need a fisherman
'Cause it's hard to sail without him.
Yes, we might as well bring seven or eight
In case a strong one blows and our'man should break.

Well, we have our jib,
And the old j.t.,
The forestay, course, top,
And raffee.
Oh, the mainstay's rigged,
And the mains'l's set,
But we can't put
To sea just yet.

We need our fisherman
To carry us away again.
We'll tie him up, and rig him right,
And stay with him morning, noon, and night.

It's a lonely life
On the deep blue sea,
But there's not a place
Where we'd rather be.
So step right up, boys!
Don't be shy!
Bring us our sheets
Then watch 'em fly!

Come, come, and come again,
Come to us, oh fishermen!
Should the seas be rough and a gale wind blow,
Then you'll be taken down below.

A CAUTIONARY TALE IN TWELVE VERSES
Chum

There once was a sailor,
And his name was Scott.
He wished for some women,
So that's what he got.

The brig he shipped out on
Was crewed by all women.
With visions of lovin'
Poor Scott's head was spinnin'!

But once he shipped out,
He realized this:
A boat full of women
Was quite far from bliss.

Though one was quite pretty,
She acted like Mom.
Another, though witty,
Was too much a Tom.

The third was a libber,
And much, much too proud.
The fourth was from Dixie
And much, much too loud.

Another, well-bred,
Had attended Yale.
The one from the Rockies
Had eyes just for whales.

The seventh was quiet.
Then came number eight.
And she was not good enough
To be shark bait.

The ninth studied rocks,
The tenth studied leather.
The 'leventh to Jack
By a phone line was tethered.

The twelfth might have worked,
But Ron capped the ship
And wouldn't let Scott have a
Relationship.

So tell me, my maties,
What would you do then?
Surrounded by women who
Talked of their men?

Oh, pity poor Scott
When I say to you:
Watch out what you wish for
'Cause it may come true.

THE STARRY STARRY NIGHT SONG (to the tune of "Vincent")
Cait Goodwin

Starry starry night
Meter nets by the moonlight
Anxious JSWOs scream out "sight!"
Weary Bill hopes the winch will work right.

Rolling rolling sea
What could that light out there be?
Deck dude pilots her m, r, e
Wake up, Ron, we're coming within three.

CHORUS: Miles and miles to go
Miles and miles we've left behind
Stumblin' round as new JWOs
But we haven't lost our minds
How much more out there can there really be?
Guess we'll sail on and see

Starry starry night
Heads'ls luffing like a kite
Hauling lines with all our might
Sorry, Ginny, we missed New York Bight.

Rolling rolling sea
Gimbled table on my knee
Tilted pans in the galley
Whisper gently to Roxanne at three

(chorus)

Foggy foggy days
Can't quite see whales through the haze
Nervous thoughts about third phase
Word Perfect will soon be all the craze.

Blowing blowing breeze
Reading all those MBTs
Shipeck grabs are just a tease
I'm clinging to my string of Karma beads.

(chorus)

Foggy foggy days
Otter trawls still do amaze
Hungry eyes begin to glaze
Science, after all, really pays.

Blowing blowing breeze
PDR melodies
Remember Gioia can't eat cheese
Don't wake mid-watch up for breakfast, please.

(chorus)

ODE TO AN OTTER TRAWL
Ginny Eckert

Those doors so mighty and strong
Cpen wide as they trail the net along,
Soaring quickly down to the sea,
Ron orders the helm to turn once to the lee.
And when it reaches the bottom, it begins its mighty call
To collect from the bottom, starfish, brittlestars and all.

As we all stand on the deck and look
And watch the line that can catch more fish than a hook.
We hope that soon a lot of fish we will see
To clean, to eat, to study.

Dragging the trawl is quite fun
But it's most exciting when it's done,
When Bill starts to bring it up
And we think of all we can have for sup.

Seven times out of twelve, we have won the battle,
Where we've been in the driving seat, in the saddle,
Pulling the reins and having them respond,
Bringing back the net full with our wishes and beyond.

But the other times, well it's been a struggle,
Sometimes Bill's happy and with the controls he does juggle.
Other times he's quite frustrated, we call him in a wad,
Just because the trawl doesn't bring back any cod.

Sometimes it's a battle to bring up the net;
The winch moans and cries and is louder than a jet.
Bill fights with the controls and Ron steers the ship;
To free the net from that on which twice it has tripped.

First there was a monster who took a big bite
Only after holding onto the net with all of its might.
We won this battle with our cunning and wit
And the next day fixed the net with the Issacs Kid.

The monster must not have been happy,
For it followed us underneath the sea
Just waiting to grab the otter trawl,
The contents, the floats, weights and all.

That day the fathometer said the bottom was safe.
Bill marked the spot for the office, for Susan and Rafe
Because no one at home will believe what happened next
Let me explain what happened and give you context.

It was dark, it was cold and C Watch was on duty,
All dressed in their foul weather gear and rubber botties.
I was in my bunk, all nice warm and dry,
As I heard Bill trying hard and the winch's battle cry.

I believe the monster snuck up from behind.
It recognized the half of the net and did not mind
That our repair job had been in quite a haste,
For it took the whole thing and left nothing to waste.

Others have their own tale as to the nature of the beast,
The one who took the net and had quite a feast.
Some think it was a squid, maybe a toxic drum,
And others think it was Neptune, quite drunk on all of our rum.

No matter what your theory, the point of this story
Is to warn you about those monsters who live in the sea.
They gobble up your data and break all of your gear,
At least they have on this cruise, C-106, this year.

WAY HIGHWAY HIGH (A WEIGH HIGH)
Jackie Ciano (BMI @ 1979)

CHORUS: oh weigh hi what a fine night for sailin'

Away with a pitch and a roll
Away high what a fine night for sailing
And freezin' my sea faring soul.

Countin' the stars high up in the heavens
Listen the riggin' is settling in
Cracking and a creaking like ghosts gone a haunting
Here her last voyage is where I begin.

CHORUS

Brace her to starboard and watch as she reaches
The mate calls "All hands" and we step to the rail
Clew up the course and air out the leaches
To bring the square rigger about as she sails.

CHORUS

The sun comes up slowly embracing the water
The call "There she blows" and "Ye better not fail"
Get her to deck or you'll not know your daughters
The long boats are dropped and we're after the whale.

Hours and miles we are ripped through the water
The strike has been made, we've let out the line
She sounds and then surfaces, she'll be a dyin'
The chimney's afire - it's the final time.

CHORUS

Sing a song of the sea and a song of the living
Of freedom of ships that are sailing no more
Walking her deck I can feel the vibration
That shook her great hull as she headed for shore.

CHORUS

THE CRAMER
Jackie Ciano (BMI @ 1989)

Oh the Cramer was a brigantine
She was steel of hull and broad of beam.

TAG: More sail, more sail, cries Captain Ron
Let's keep the wind wagon sailing

She was loaded down with science gear
But we ripped it there or we lost it here.

TAG: Deploy, deploy, cries Doctor Bill
For science never is sleeping

The mighty stream was just as they said
It was blue blue blue and dead dead dead
With set and drift all figured in
We realized we'd never see land again.

TAG:

We fixed our course and were making way
The Sargasso Sea on the seventh day
We had no winch but did neuston tows
Got Sargassum crabs and histrio.

TAG:

Bermuda on the eleventh day
When the winch was fixed we sailed away
Yet while in port there was damage done
For the cavern had been way-much fun.

TAG:

Now science took an amazing turn
And the dinosaurs would burn, burn, burn
There were CTD's and bottles slung
What was that quote from our dearest chum?

TAG:

We hit the mount on the eighteenth day
For rocks or mud or silty clay
We missed the bear but we payed the sea
And the shipeck bucket is history.

TAG:

We dragged the banks to find some fish
It was Gretchen's hope and Ginny's wish
The net held out for the cod and hake
For Larry Lobster, and Robin's sake.

TAG:

We sighted blows and had spied some whales
Then Andy mentioned he'd seen a tail
It was black and broad he explained to me
A right whale shouted I blissfully.

TAG:

A port like Shelburne there never was
With the laundrymat and Claudia's
When we sailed away at the cannon's cry
They stood on the dock and all waved goodbye.

TAG:

The Karma Penguin on E-JO's head
The swizzles on the quarter deck
The hair wraps and granola dudes
The sun/moon fixes and amplitudes

There were shooting stars and squalls at night
There were azimuths and celestial sights
There were gybes, and tacks and strikes and sets
And sparkling dinoflagellates.

TAG:

(the alums sing this next verse....)

Six more weeks on the sea sounded good
We all learned more than we thought we would
We're all alums at the end of phase six
Still trying to get our celestial fix.

TAG:

King Neptune kept us safe and sound
Now sailors all we are homeward bound
To our separate lives we'll go separate ways
With the memories of our <u>Cramer</u> days.

TAG:

So schooner hugs to you all who be
Called by the voice of the sea
More sail, more sail cries Captain Ron
Let's keep this wind wagon sailing

Deploy, deploy cries Doctor Bill
For science never is sleeping!